INTERAVIA

REVIEW OF WORLD AVIATION

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Dialogue between Two Continents

VOLUME IX 12 1954

46 years of aeronautical construction

1908—the first Fiat aircraft engine

Fiat's line of trainers:

G 46	**G 49**	**G 59**
G 80-1B	**G 80-3B**	**G 82**

INTERAVIA

Review of World Aviation

Volume IX | No. 12 | 1954

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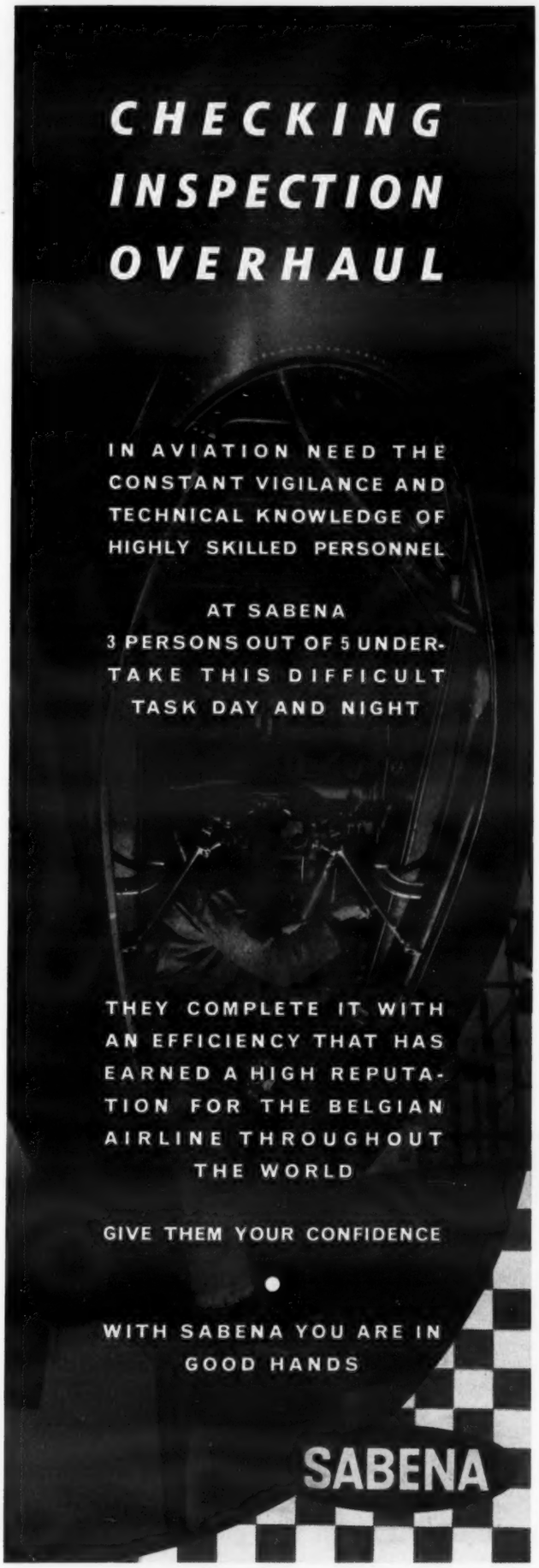
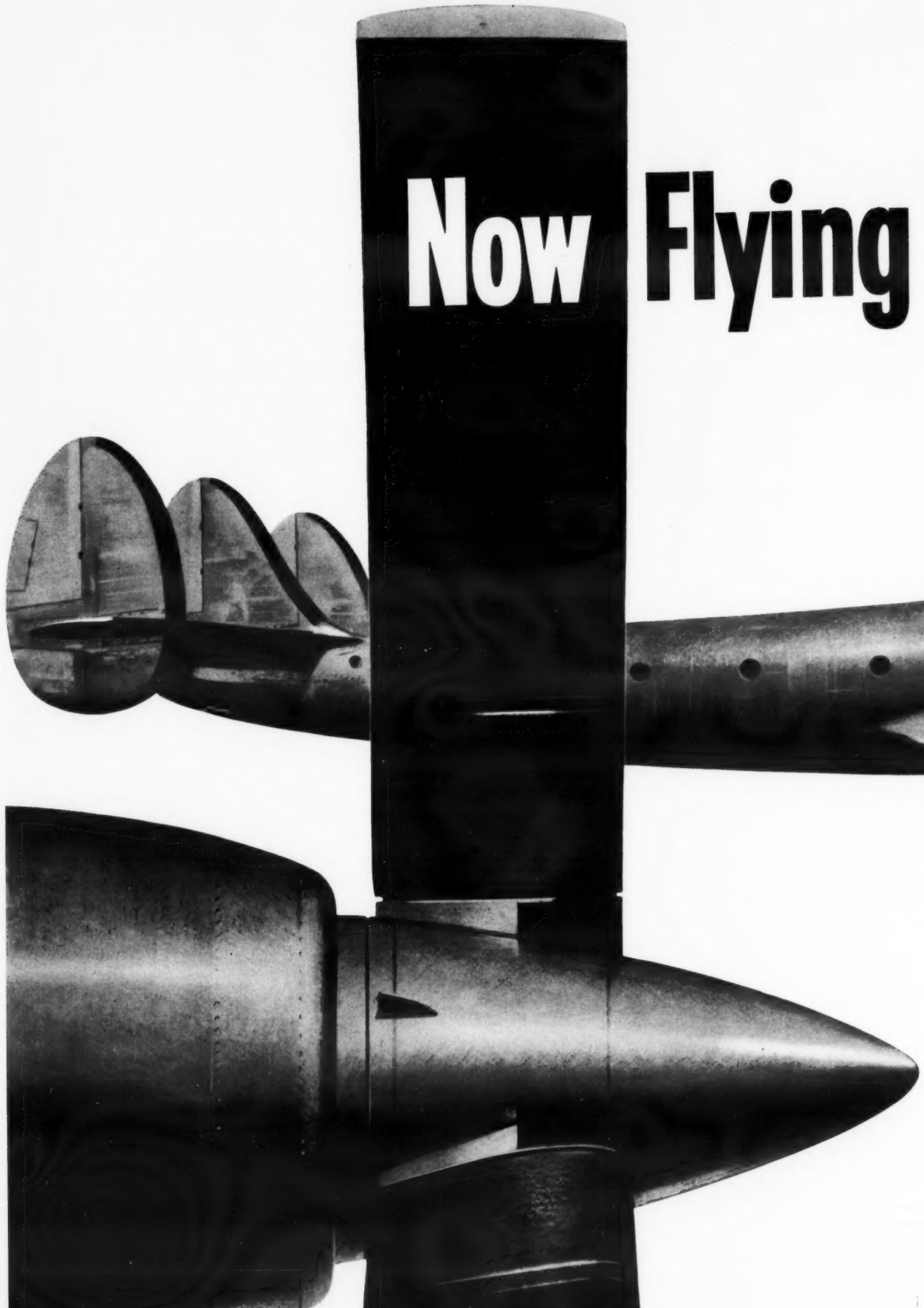

CHECKING
INSPECTION
OVERHAUL
IN AVIATION NEED THE CONSTANT VIGILANCE AND TECHNICAL KNOWLEDGE OF HIGHLY SKILLED PERSONNEL
AT SABENA
3 PERSONS OUT OF 5 UNDERTAKE THIS DIFFICULT TASK DAY AND NIGHT
THEY COMPLETE IT WITH AN EFFICIENCY THAT HAS EARNED A HIGH REPUTATION FOR THE BELGIAN AIRLINE THROUGHOUT THE WORLD
GIVE THEM YOUR CONFIDENCE
WITH SABENA YOU ARE IN GOOD HANDS
SABENA


Now Flying !

World's Fastest Propeller-Driven Airliner

Lockheed's Turbo-prop Super Constellation

Nearly 100 miles an hour faster than any propeller airliner now in service. This powerful new Super Constellation, equipped with turbo-propeller engines, is now flying for the U. S. Navy. Its tests promise new speed, new performance, and greater economies in the transport aircraft field. This new transport, Model 1249, is another example of Lockheed transport leadership. Watch for important new announcements about this turbo-prop Super Constellation.

Lockheed *AIRCRAFT CORPORATION, BURBANK, CALIFORNIA, U. S. A.*

TAKE YOUR NEXT EUROPEAN TRIP BY

VICKERS VISCOUNT

THE AIRCRAFT APPRECIATED BY THE EXPERTS

Air France has just equipped its main European services with the modern aircraft best suited to medium-stage routes, the Vickers "Viscount". With its four Rolls-Royce "Dart" turboprops, the "Viscount" has a cruising speed of 320 m.p.h. at 25,000 ft.

For the pilot it is the most "docile" of aircraft, for the passenger the most comfortable. No more noise on board, no vibration, a maximum of air volume, a maximum of visibility. Fully sound-proofed and pressurized, the cabin is 40 ft. long and nearly 10 ft. wide, with big windows giving passengers a wide view outside.

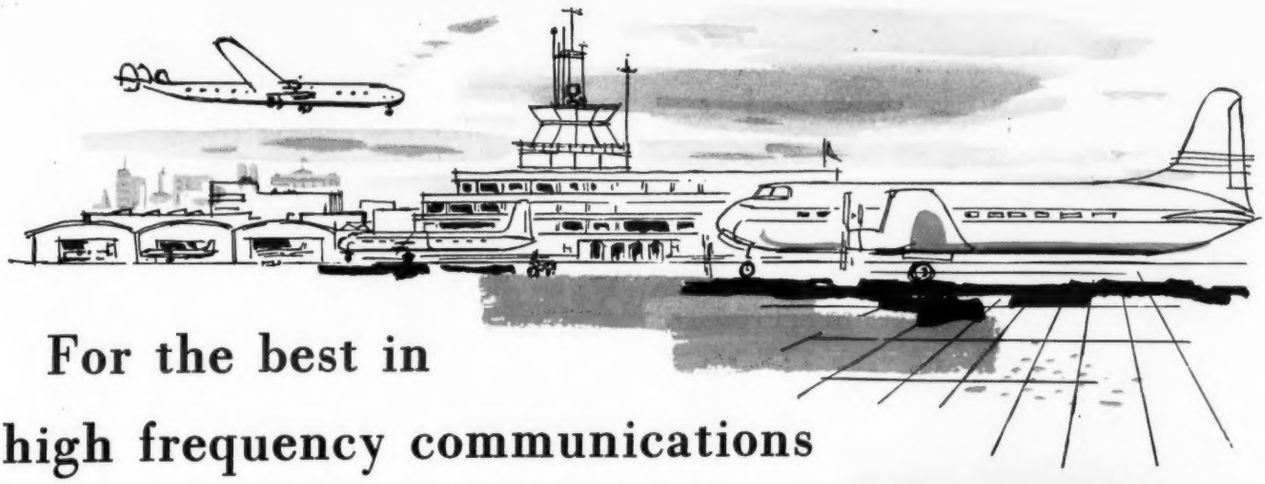
Air France "Viscounts" operate services every day to:
London, Hamburg, Stockholm, Geneva.
Every weekday to Rome.
Four times a week to Copenhagen.
Three times a week to Vienna, Munich, Milan.

All these services, except the special "Epicurien" service to London, are tourist class.

Air France serves 35 cities in Europe. Its network is the longest in the world, with 230 points of call in 72 countries and five continents.

AIR FRANCE *35 years experience at your service*

INFORMATION FROM TRAVEL AGENCIES OR AIR FRANCE OFFICES IN PARIS, LYONS, STRASBOURG, NANTES, BORDEAUX, MARSEILLES, TOULOUSE AND NICE

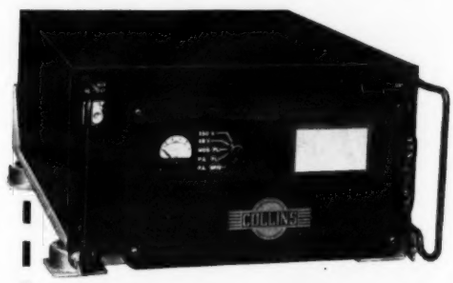


For the best in high frequency communications

COLLINS

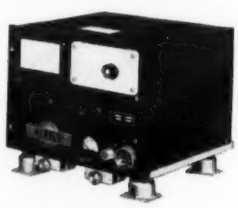
618S Transceiver with the 180-L automatic antenna tuning unit

FOR MANY YEARS the Collins designed AN/ART-13 was *the* outstanding HF Transmitter in aviation — commercial and military, domestic and international.
After the ART-13 came the Collins 18S HF Transmitter-Receiver. In incorporating the same quality features and advanced design detail as the ART-13, the 18S series has served the industry well and has been accepted universally by the commercial and military operators.
Now the 618S Transceiver, featuring 144 channels, 100 watts, modular construction incorporating mechanical filters and crystal saving circuits is taking its place in the Collins line of HF equipment.
Already purchased and in service by many of the great airlines of the world, this transceiver has now been accepted by the Air Force and is being acquired for use in their global operations.
The 618S with the 180-L is proving again Collins leadership in the HF field.



Collins 618S 144 Channel HF Transceiver for all purpose air-borne communications.

Collins 18S 20 Channel HF Transceiver.



Collins 180L-2 Automatic Antenna Tuning Unit for use with 618S or 18S. Makes all antenna adjustments automatically.

Collins 614D Frequency Control Unit for use with the 618S Transceiver.

Shockmounts

350S-1 Shock feet for air-borne or mobile installations.
350S-2 No shock feet. Designed for shock mounted shelf.

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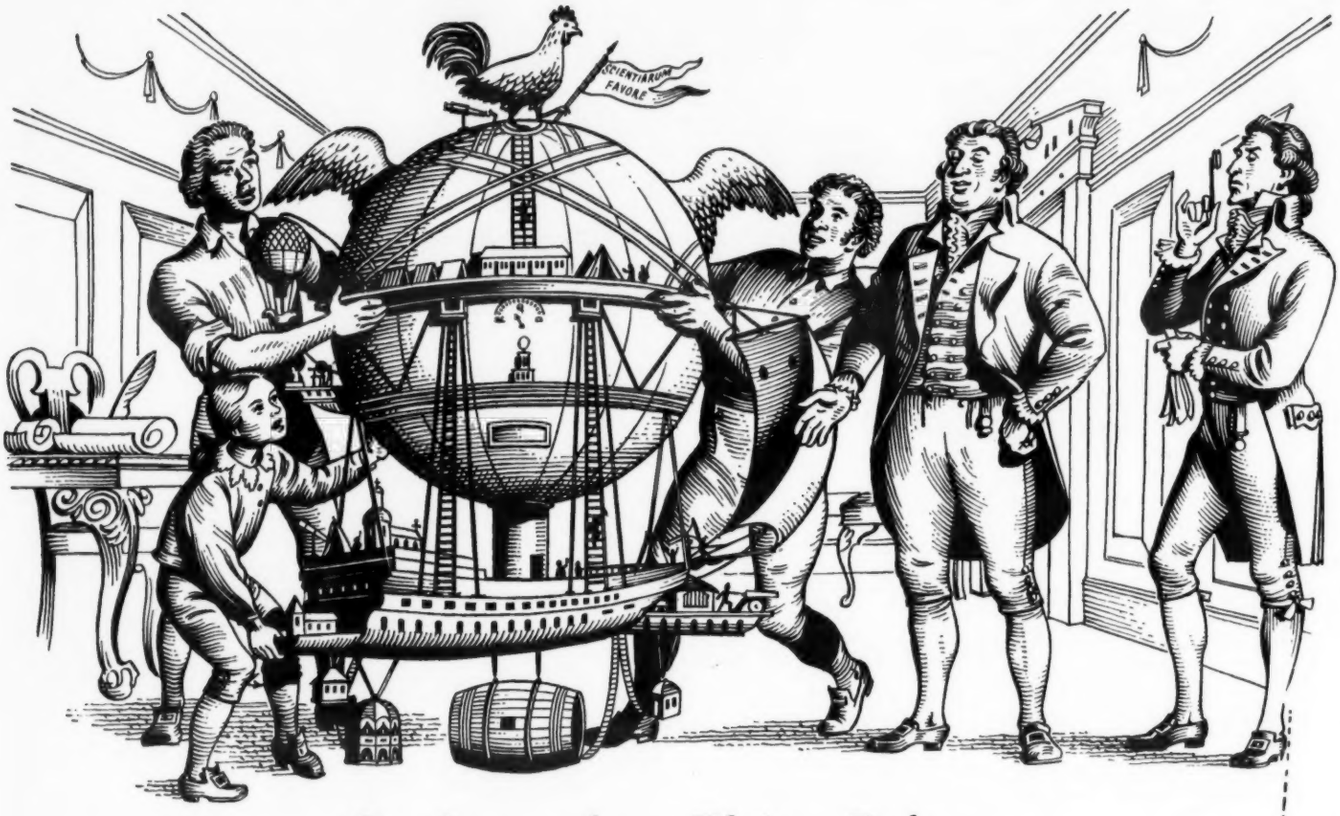
COLLINS RADIO COMPANY, Cedar Rapids 8, Iowa, U.S.A.



Professor plans Flying Palace

VIENNA, 1804

PROFESSOR ROBERTSON has designed a stupendous aircraft to carry sixty passengers on a six-months non-stop flight of scientific observation. The giant has a 3-decker gondola containing kitchen, store, laboratories, music room, cabins and ladies' withdrawing room. Surmounting the machine, symbolising vigilance, will be an effigy of a rooster, so enormous as to contain an observatory in its eye.

" Aircraft design should be bolder," said the Professor. " If you think that six months is overdoing it, remember that there is no ground service yet. It will, for example, be many years before somebody invents the BP Aviation Service for quick, efficient refuelling."

AVIATION BP SERVICE

ANGLO-IRANIAN OIL COMPANY LIMITED

MAN BEHIND THE C-119

Berlin or Bombay . . . Nome or New Guinea . . . wherever the *Flying Boxcar* is based, there's a Fairchild field representative on the job. These men and the versatile military air transports they tend are serving all over the world, in every type of climate, under the most difficult operating conditions.

As Fairchild trouble-shooters, these expertly trained technicians work closely with U. S. Air Force and Navy engineering officers and men, keeping the Fairchild C-119 operating at maximum efficiency.

Fairchild is proud of these men, the combat-proven *Flying Boxcar*, and the important part both play in the defense of free men everywhere.

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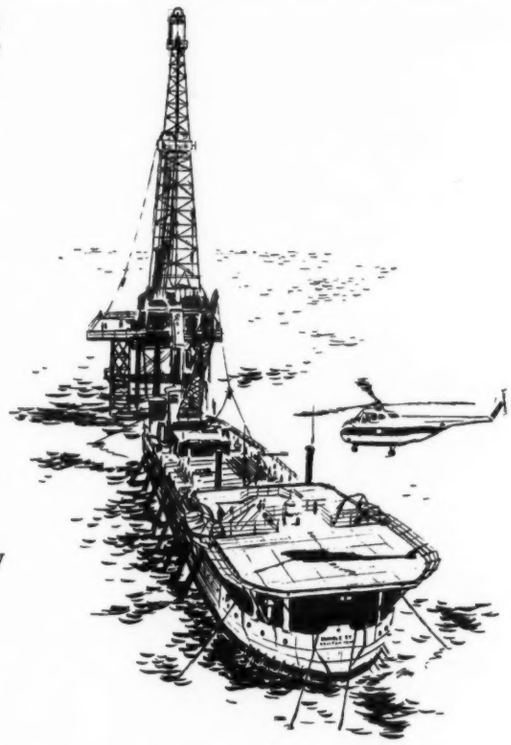
United Airgram

UNITED AIRCRAFT EXPORT CORPORATION

SIKORSKY S-55 HELICOPTERS SPEED DEVELOPMENT OF OFF-SHORE OIL WELLS

Sikorsky S-55 helicopters once again are demonstrating their efficiency and rugged dependability in commercial service, this time by providing over-water transportation for oil well drilling crews who work far out in the Gulf of Mexico.

In a pioneering operation which began last spring, big Sikorskys have been used in daily scheduled service to solve various difficult transportation problems encountered in off-shore oil development work. This operation centered along the continental shelf which parallels the U.S. coastline, off Texas and Louisiana. Here some drilling sites are now as far as 45 miles from supply bases, and located in waters as deep as 100 feet. Seas are often rough. Transportation by boat is slow, frequently hazardous, and always uncomfortable for workmen susceptible to seasickness. Helicopters offered solutions to these problems of boat transportation.



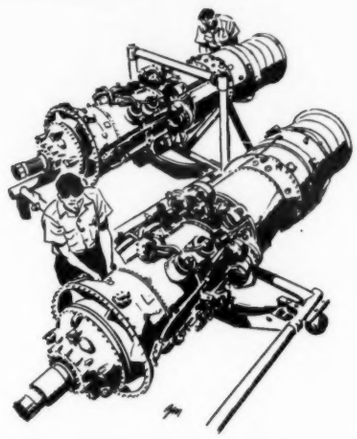
The initial demonstration of helicopter use for crew transportation was the operation of services for one major company, between Grand Isle, on the mainland, and one area off Louisiana. The flying service was provided by Petroleum Helicopters, Inc. of New Orleans. Using big S-55s, this firm handled a steady flow of workmen - as many as 110 per day - between the mainland and a number of drilling platforms or floating tenders on which landing decks were built for the helicopters.

Success was immediate. The helicopters were able to operate in nearly every kind of weather. Crews reached the job in 30 minutes instead of many tiresome hours. Seasickness and many safety hazards were eliminated. The helicopters were able to provide fast ambulance service in case of illness or accident. They eliminated the need for many costly boats once required for both transportation and emergency standbys.

Currently, plans are being made for extension of helicopter transportation to a large number of off-shore drilling and production operations. Almost all drilling platforms now under construction, and most drilling tenders, are being equipped with platforms on which the big Sikorskys can land and takeoff.

NEW DOUGLAS TRANSPORT TO HAVE PRATT & WHITNEY AIRCRAFT T-34

Pratt & Whitney Aircraft's 5700 h. p. T-34 turboprop engines will power the new Douglas C-133A, a giant transport aircraft to be built for the U. S. Air Force.



Prototype of the four-engine plane is now under construction at the Douglas plant in Long Beach, California. Flight is anticipated in mid-1955.

Specifications of the new transport are still confidential. It is known, however, that the C-133A will be larger than the Douglas YC-124B Globemaster II. This aircraft is the largest regular production military transport now in service.

Power plant package for the C-133A was evolved from the YC-124B engine installation. The YC-124B is a Globemaster II redesigned for four P&WA T-34 turboprop engines. Normally, the Globemaster is powered by four 3800 h.p. P&WA R-4360 piston engines.

A limited T-34 production program at Pratt & Whitney Aircraft is now supplying turboprop engines for the YC-124B, for Air Force and Navy turboprop versions of the Lockheed Super Constellation, designated the C-121F and the R7V-2 respectively, and for Boeing C-97J Air Force turboprop Stratofreighters.

NEW HAMILTON STANDARD PNEUMATICS LABORATORY LAUNCHES BOMBER SYSTEM TESTS

An extensive addition to Hamilton Standard's advanced pneumatics laboratories at Windsor Locks, Connecticut, has been opened with a new job: testing a Hamilton Standard air conditioning and pressurization system being developed for a still-secret supersonic military bomber.

The recently completed addition houses highly specialized test equipment, much of which is completely new to the division's development laboratories. The facilities reflect the growing performance required of aircraft equipment today, and the division's anticipation of future aircraft requirements.

New test equipment includes a sand and dust chamber, a shock test rig, a centrifuge device to simulate the forces imposed on equipment in high speed turns and pull-outs, and a simulated jet aircraft cockpit. Other equipment installed in the new facility includes four test booths for air conditioners, five valve test rigs, an altitude chamber, a salt spray test chamber, and an electronic vibration machine for fatigue testing air conditioning equipment. New also is an enviromental chamber, where the climate of any place in the world can be simulated.

The new test facilities augment one of America's outstanding experimental test areas. Now in operation, in addition to the pneumatics laboratory, are propeller and jet engine test cells, laboratories for fuel controls, hydraulics, mechanical tests, vibration and electronics, a propeller balancing room, and a separate building housing a combustion laboratory.

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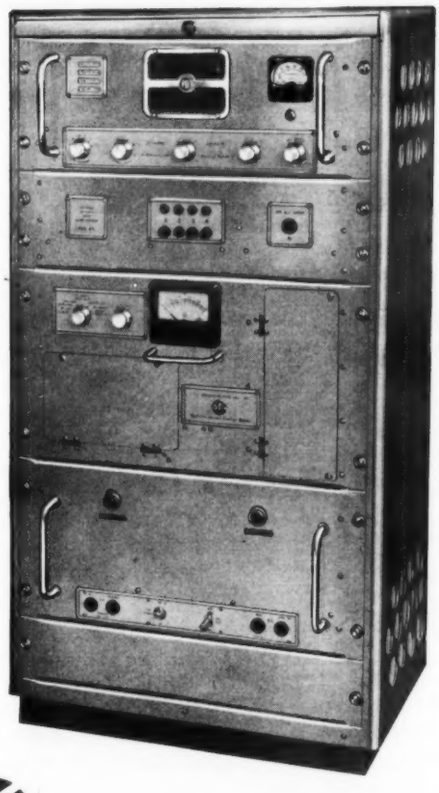
European Offices: 3-5 Warwick House Street, London SW1, England

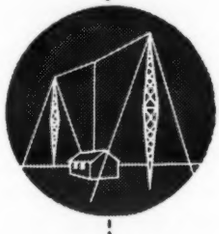
60 WATT H.F. FIXED STATION

This completely new Pye equipment has been specifically designed for point-to-point communication and will fulfil equally well a ground-to-air role in air traffic control systems.

Push button control brings any one of four preselected channels into immediate operation ; this facility is also available when the equipment is installed for remote unattended operation. The 60 watt Fixed Station Transmitter offers R/T, C/W, or M.C.W. operation with 'break-in' facilities on telegraphy.

The equipment is suitable for unattended operation in the tropics.





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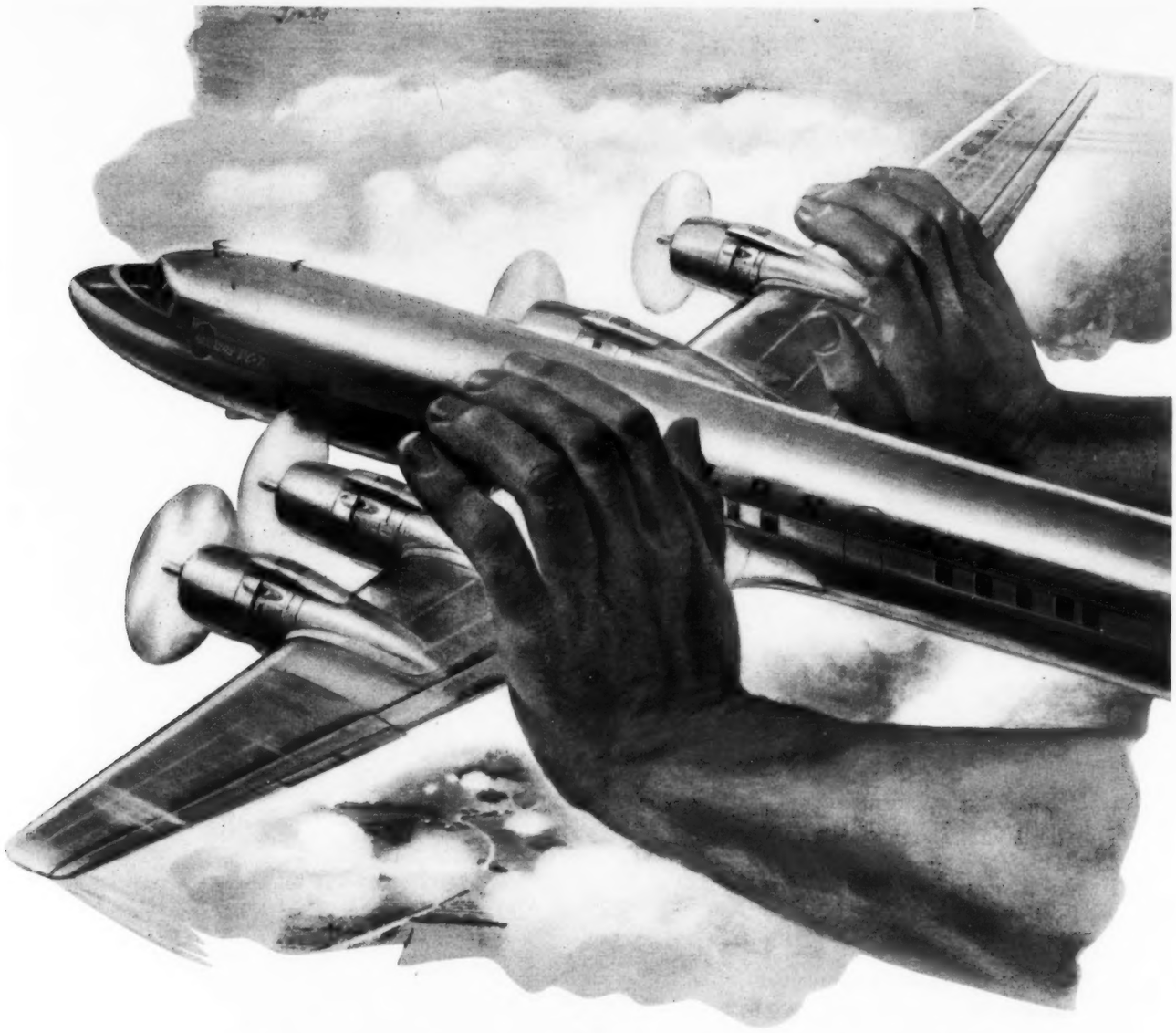

Even the exhausts "push"

to help make the DC-7 America's fastest airliner

For years, engineers have longed to harness the power lost through airplane exhausts.

Now they have succeeded—with the ingenious turbo-compound engine. "Captured" exhaust-power gives propellers *20% more push.*

Four of these engines turn up 13,000 horsepower in the new Douglas DC-7. And the DC-7 makes the most of it! Its sleek, straight-line design cuts air "drag" to a minimum ... it flies you up to *50 m.p.h. faster* than any other U. S. plane in normal airline operation.

The DC-7 offers you many luxuries not found in other airliners. For example, its air-conditioning system keeps the cabin comfortable on the ground, as well as in flight.

You get more for your fare on Douglas airliners. That's why they are the 2-to-1 choice of *experienced* air travelers.

Douglas airliners circle the globe. Fly the DC-6, DC-6B or the new DC-7 on these leading airlines :

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**Flying soon*

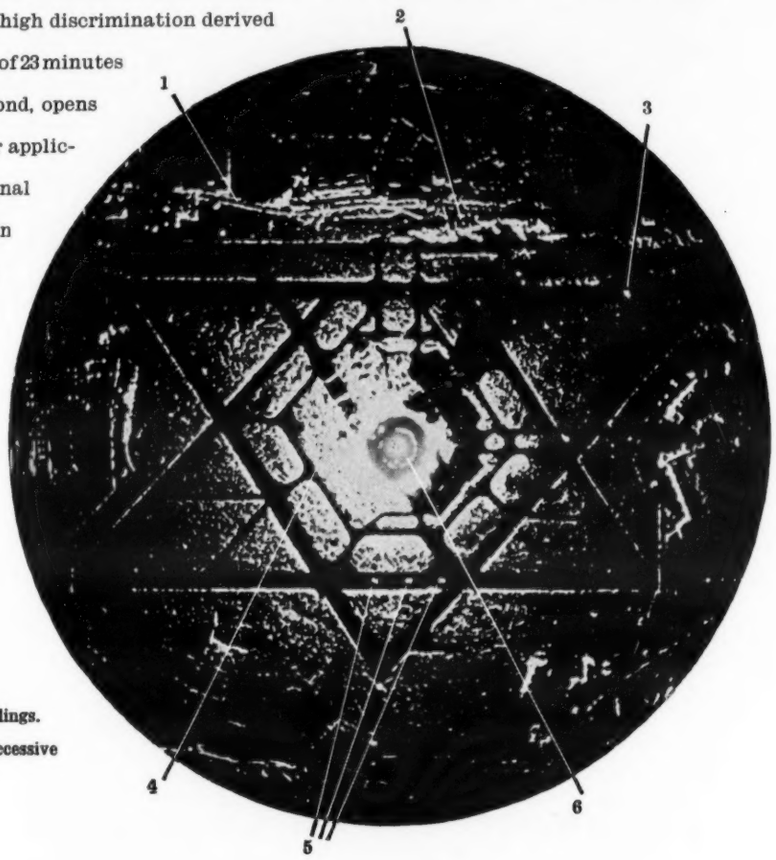
DOUGLAS

Twice as many people fly Douglas as all other airplanes combined

801

London Airport on the Q band

Designed for operation in the 8 mm (Q) band, the new Decca Millimetric Radar provides very precise information on the surface movement of aircraft and vehicles on large modern airports, or of surface craft in harbour areas. The extremely high discrimination derived from the narrow horizontal beam of 23 minutes and short pulse of 0.05 microsecond, opens new fields in a wide range of radar applications of the greatest operational importance. This discrimination in bearing and range, and the high quality of the receiver and display system, are clearly shown in the accompanying illustration—reproduced from a photograph taken on site at London Airport.



1 Main Road.
2 Existing airport buildings.
3 Aircraft awaiting take-off clearance.
4 Construction area for new airport buildings.
5 Aircraft taking off, seen on three successive rotations of the Scanner.
6 Radar site on top of control tower.

Other radars developed by Decca Radar for civil and military use, are:—

AIRFIELD CONTROL.

The Decca Type 424 approach and control radar is extremely economical to instal and operate. With it, the operator can pick up an aircraft approaching the airfield, and direct it onto the runway. It is available in static, mobile or air-transportable form.

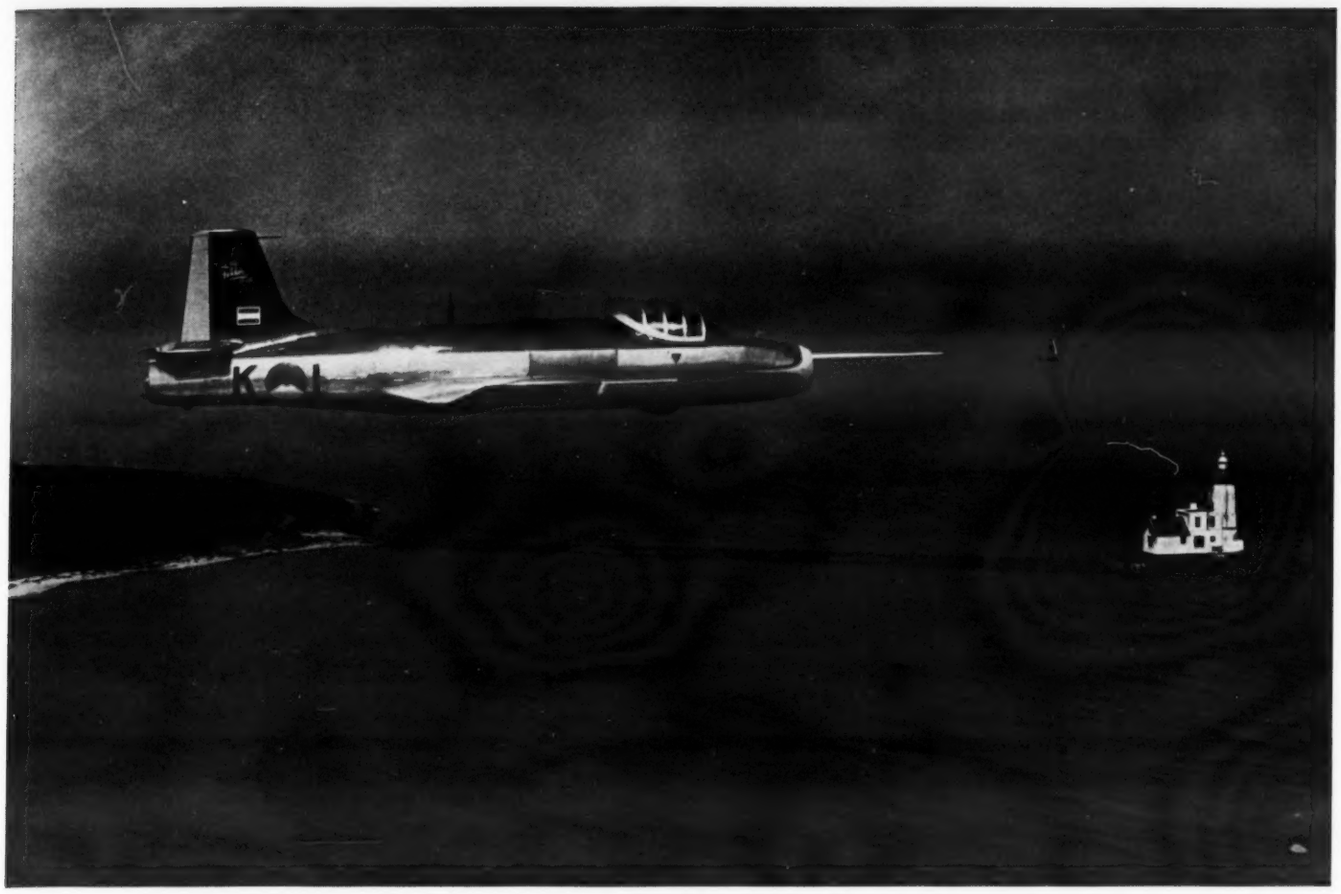
STORM-WARNING.

The Decca Type 41 is a ground equipment for detecting the position, speed, direction and formation of rainstorms within a radius of 200 miles or more. A similar equipment, the Type 40, gives a range of up to 120 miles.

DECCA Radar Systems Division

DECCA RADAR LIMITED · LONDON · ENGLAND

D.R.361



FOKKER S.14 "MACH-TRAINER"

ROLLS-ROYCE "DERWENT" 8 OR "NENE" 3 TURBINE

The highly specialized FOKKER S.14 " MACH-TRAINER " is an indispensable part of the planned fighter pilot training programs of the Western Air Forces.

The S.14 " Derwent " and " Nene " versions have been extensively tested by British, American, Netherlands, French, Italian and other foreign teams and the aircraft has demonstrated its excellent qualities as an advanced jet trainer.

Fokker

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- Chamonix
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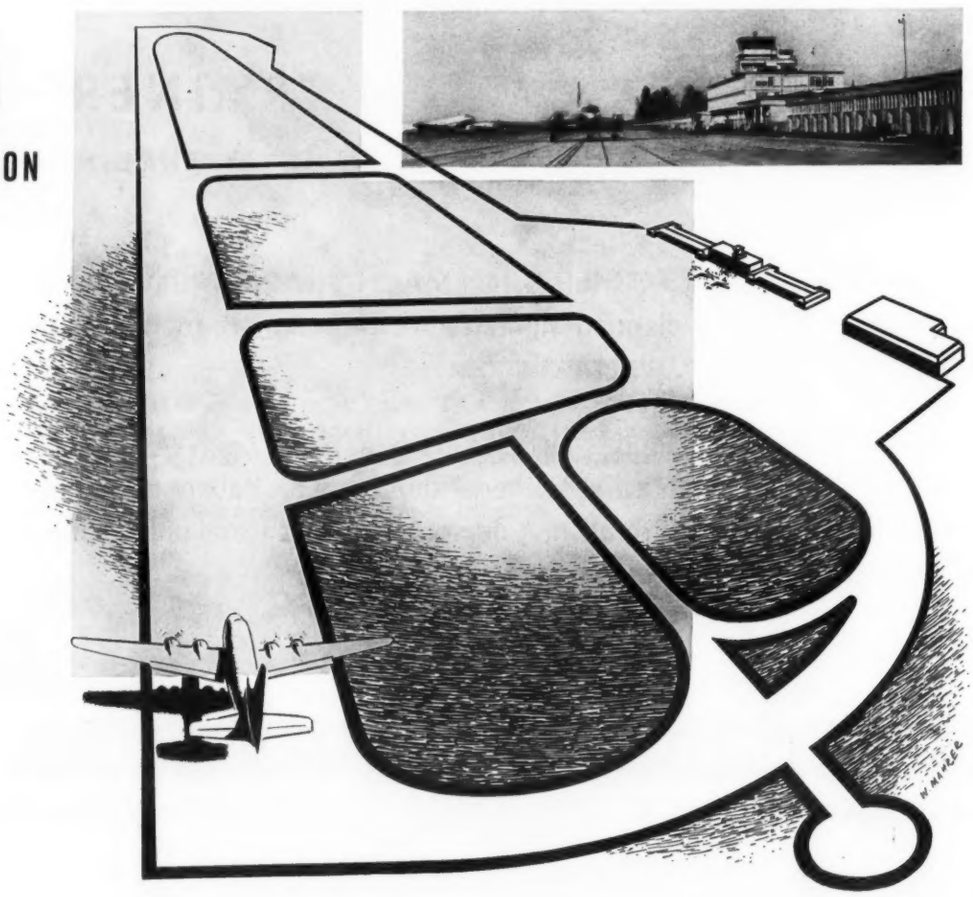
- Val d'Isère

For your winter sports holiday

Geneva international airport occupies a key position in relation to the winter sports centres in Valais and Savoy. By flying to Geneva you save time and prolong your winter holiday. Special direct services to the French centres.

GENEVA

INTERNATIONAL AVIATION CENTRE



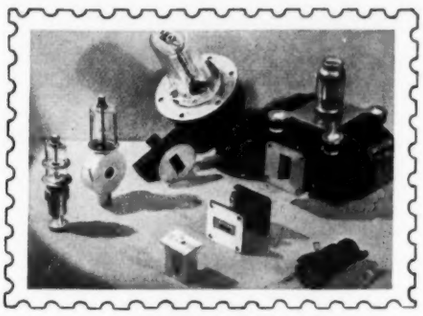
Cie FRANÇAISE THOMSON-HOUSTON

IN THE FRONT RANK OF EUROPEAN

ELECTRONIC MANUFACTURERS

VAPOTRONS

CFTH



VHF TUBES

PORTABLE TRANSMITTER-RECEIVERS

G.C.A. EQUIPMENT

RADIO-COMMUNICATIONS

AUTOMATIC RADAR

High-power
RADAR

MARINE RADAR

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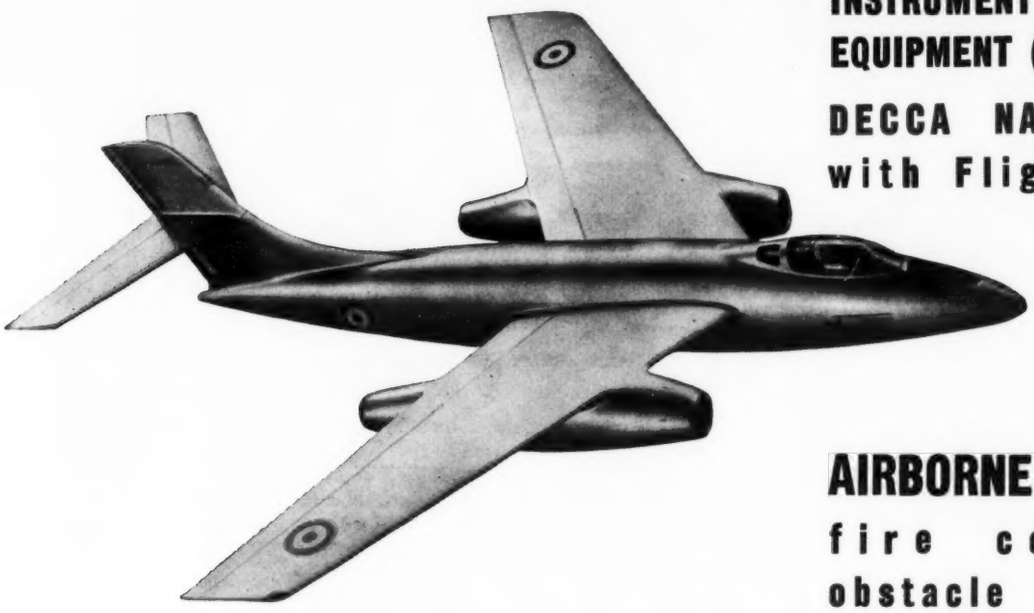

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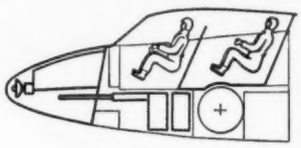
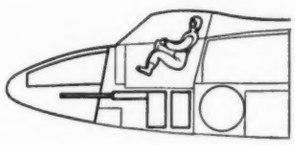
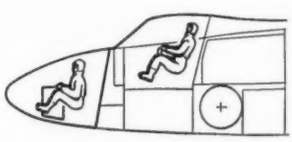


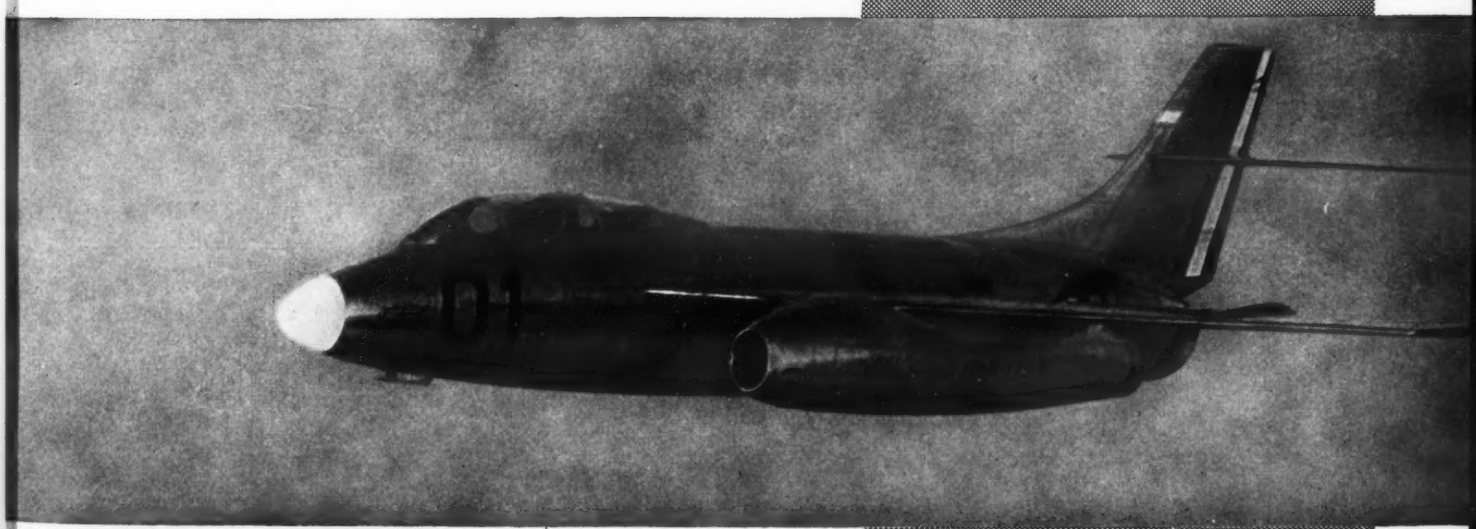
All-weather fighter



Ground attacker



Bomber



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Aircraft of this type flown by crews of the Royal Air Force were placed first, third and fourth in the recent New Zealand Air Race in which the winner flew from London to Christchurch in under 24 hours. Also in production are the Canberra bomber and trainer.

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INTERAVIA

Deadline Notes

No. 12, 1954

TEST PILOT BECOMES MINISTER

In the Cabinet reshuffle which Prime Minister Pierre Mendès-France undertook shortly before his departure for the United States, André Moynet, Chief Pilot to Avions Hurel-Dubois, who represents the Department of Saône-et-Loire in the French Parliament, was appointed Secretary of State for Youth Problems. The Ministry of Housing and Reconstruction, which had been provisionally under Minister of Transport and Public Works Chaban-Delmas, was taken over again by Maurice Lemaire, who left the Cabinet in August 1954. Finally Philippe Monin became Secretary of State for Economic Affairs.

U.S.A. TO PAY FOR "D.E.W." RADAR NETWORK

The Governments of the United States and Canada have agreed that a "single authority" - the United States - should build the Distant Early Warning radar line in the far north of the continent, according to a statement issued simultaneously in Washington and Ottawa. According to unofficial estimates, the cost of this radar line will amount to about $1,000,000,000. - A spokesman for the U.S. Defense Department has stated that the question of manning and paying the cost of operating the chain has not yet been settled. Seven radar stations in the American sector of the line are already in operation along the north coast of Alaska. When completed, the whole line will extend eastward for about 3,000 miles, probably terminating in Greenland, where the United States already operate a number of stations.

HELICOPTER FARES LOWER THAN TAXIS

Los Angeles Airways is offering travellers lower fares on its helicopter services within a radius of 65 miles than those charged by Los Angeles taxis, Interavia's West Coast correspondent reports.

TORE NILERT KNIGHTED

Tore H. Nilert, President of the U.S. branch of Scandinavian Airlines System, was knighted by Swedish Prime Minister Tage Erlander in the name of the King of Sweden, on completion of the first Scandinavia-Los Angeles trans-Arctic service. The Swedish Ambassador and S.A.S. President Per A. Norlin also attended the ceremony. Nilert played a leading part in the preparations for the service, and the grant of American landing rights was largely due to his efforts.

GOVERNMENT FINANCE INSTITUTE CONTROLS IBERIA AND AVIACO

The Spanish Government has instructed the Instituto Nacional de Industria to acquire and administer the majority of the shares in the private airline Aviación y Comercio S.A. (Aviaco). As the Institute already holds the whole capital in Iberia, Lineas Aereas Españoles, it will now be able to coordinate Spain's State-operated and private air transport. In particular aircraft procurement and route networks are to be rationalized.

NATIONALIZATION OF JAPAN AIR LINES

The heavy operating losses sustained by Japan Air Lines, amounting to 485,077,684 yen for the period January to September 1954 and to 779,227,969 yen for the whole 1953-54 business year (to September 30th, 1954), have already led to the resignation of Board Chairman Kunizo Hara. - Transport Minister Mitsuji Ishii has now stated that the Japanese Government, which already holds half the shares, plans to turn J.A.L. into a pure State-owned airline and to reorganize the management and operation.

U.S.A.F. SQUADRON UNDER DUTCH FLAG

The U.S. Air Force officially "transferred" its 512th Fighter Interceptor Squadron, equipped with North American F-86 Sabres, to the Royal Netherlands Air Force at Soesterberg on November 16th, 1954.

* From INTERAVIA's world-wide news service, including INTERAVIA AIR LETTER, the daily international aviation news digest. — No part may be reproduced without written permission.

This is the first time that an American unit - under N.A T.O. - has been placed under a foreign defence organization. Dutch command authority extends, however, only to operational questions. Logistically and from the point of view of organization the squadron remains part of the 406th Fighter Interceptor Wing stationed at Marston, England.

CANADA PREPARED TO TRAIN GERMAN AIRMEN

Royal Canadian Air Force Headquarters have declared themselves prepared in principle, Interavia's Toronto correspondent reports, to train German air force personnel at Canadian bases, as soon as the admittance of West Germany to Western European Union is ratified.

COMMONS DEBATE ON B.O.A.C.'s DC-7D NEGOTIATIONS

In the House of Commons debate on civil aviation on November 15th, both Conservatives and Labour demanded an immediate impartial examination of British Overseas Airways Corporation's procurement plans, and in particular of the two aircraft types covered by these plans at the present time: the Bristol Britannia and the projected Douglas DC-7D with propeller turbines (Rolls-Royce RB-109, or a new version of the Napier Eland, or ...?). - The Conservative spokesman warned against the adverse effects which B.O.A.C.'s negotiations for American aircraft must have on British aircraft export prospects.

In his reply Minister of Transport and Civil Aviation John Boyd-Carpenter stated that whatever happened B.O.A.C. must provide itself with the equipment it needs to compete with other airlines, even if this meant buying American aircraft. However, no final decision has yet been taken.

NEW BRITISH REQUIREMENTS FOR PRESSURE CABINS

The new Air Registration Board requirements for pressurized airliners will have widespread effects on the British aircraft industry and probably also on foreign aircraft manufacturers who supply equipment to Britain. In future, manufacturers of pressurized aircraft will have to provide two full test specimens, one for static and one for fatigue tests. Two more will probably be needed for flight testing. In addition a large number of components will be required for A.R.B. tests. The effect on development costs and time can be imagined.

*

WORKSHOP BRIEFS ...

According to American reports, a new interceptor fighter with combined rocket-plus-jet power is under development in Britain. Both A.V.Roe and Saunders-Roe are said to be working on such projects. * A second Grumman F9F-9 Tiger supersonic fighter has begun flight tests. * The first Canadair Sabre V1s are coming off the production line. * Henry Wiggin & Co. Ltd., Birmingham, announce that the corrosion and heat-resistant alloy Nimonic 90 can also be used for springs of all kinds (e.g. valve springs). * Lockheed Aircraft Corp., of Burbank, California, has so far made no comment on the rumour that it is working on a jet tanker. * U.S. Navy and Convair plan to accelerate their joint development work on water-based fighters. Additional staff have been transferred to Convair's Sea Dart development section, and a third prototype of this hydroski-equipped Navy fighter is to be completed before the end of the year * Marquardt Aircraft Co., Van Nuys, California, has developed "two-dimensional" ramjets to improve take-off and hovering performance of helicopters. The new engines are mounted in the rotor blade tips and are both aerodynamically and structurally integrated with the blades. * Aviation circles in San Diego report construction progress with Ryan Aeronautical Corp.'s jet-powered vertical riser. Bell Aircraft is also said to have a jet VTO prototype in final assembly. * Hunting Percival P. 74, a ten-seat helicopter with two Napier Oryx engines, is scheduled to begin flight testing in the late summer of 1955. * The Boeing B-52D, latest version of the eight-jet Stratofortress, has been ordered in quantity. Total value of the order exceeds $305,000,000. * Fairchild is investigating the possibility of fitting a version of the C-123B assault transport with propeller turbines.

* * *

INTERAVIA • PUBLISHERS AND EDITORS

Dialogue between Two Continents

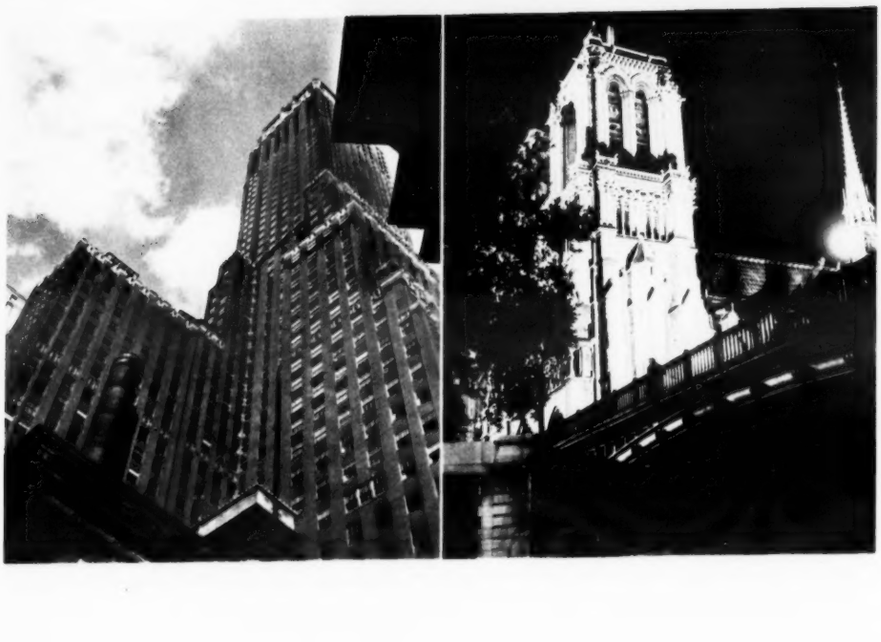
When, a few month ago, the Editors assembled to discuss the subject for *Interavia's* Christmas issue they were initially in agreement on one point only: as far as possible, military questions should be avoided. Finally, perhaps because the press in all countries was full of possible or desirable talks between East and West, they came upon the idea of attempting a conversation between West and West, between the United States and Europe. They little realized at the time what they had started . . .

Quite a number of distinguished authors got cold feet—if the reader will pardon the expression. It is not always considered politic to tell the truth, even among friends. Perhaps this is an error of the times; perhaps a little more frankness would facilitate international relations and make life easier for the ordinary mortal. Refusals were not too many—but they were also not exactly encouraging. On the other hand they were understandable: the Editors had asked for a certain degree of criticism, coupled with due attention to the positive results of international cooperation. What they wanted to avoid above all was "birthday speeches," fine-sounding phrases without content or background.

The issue is now complete, and the reader will see for himself that the list of authors is impressive. The subjects they discuss and the points of view they put forward are also of interest. Without knowing it, they have often dealt with the same subject but–just as the Editors had planned–from different sides of the Atlantic.

For example, a gifted and influential United States Senator, who wishes the Old Continent well, expresses certain misgivings, while the president of an important European industrial association sets out to dispel these misgivings. The Director General of the International Air Transport Association refuses to see any difference between American and European air transport, but even so has to admit at the end that differences do exist. The President of one of the United States' largest airlines returns impressed from a trip to Europe, but considers that certain details could be improved. European engineers compare industrial planning in the Old and New Worlds, with articles on research and production. Electronics and airports are other subjects reviewed. An American industrialist goes cautiously into the immediate future of commercial transport design, while the Sales Director of another major American manufacturer does not seem to take quite the same view. And—wonder of wonders—a European transport expert, and one who will not be flying until tomorrow, comes back from the United States full of rosy optimism.

It is Christmas . . . and optimism does us all good. The Editors would therefore like to pass it on to their readers on the eve of a new year, along with their sincerest greetings. *EEH.*



"Mariage de convenance"

Bad weather ahead?

"When meetings such as the present one unite representatives of different countries or different continents, it is the custom to exchange compliments, to stress the community of views and place the meeting under the sign of friendly relations (which will go on improving). Permit me, for once, to break with this pleasant tradition and, touching one of the most important aspects of relations between the New World and Europe, to open my address by stating that relations between the two continents—the old and the new—are bad, so bad in fact as to cause lively anxiety."

Such are the words with which the German American Robert Jungk introduces a paper entitled "Europe and American Technocracy" written for the *Rencontres Internationales* in Geneva early in September 1954.

Jungk's statement may appear exaggerated. There is no question of an openly hostile attitude in either Western Europe or the United States. There are still a great many walls in Europe which do not bear the chalked inscription, "U.S. go home." Similarly one can spend a long time in the United States before one encounters the opposite slogan, "To hell with Europe!" Yet there is something in his contention. Quite apart from Communist tirades, the leading articles in the opinion-forming press on both sides of the Big Pond have not been exactly overflowing with friendliness these past few months. What is wrong?

To get to the real root causes of the present mutually critical attitude, it is essential to avoid attributing too much importance to day-to-day events. The sharp-tempered comment on the breakdown of the European Defence Community . . . the hosannas cried by the press at the astonishing ease with which the London and Paris agreements were reached on Western European Union . . . the eve-of-election statements by Republicans and Democrats on U.S.-European relations . . . the "Communist check" to which a number of European aircraft firms were recently subjected by a U.S. Senate committee . . . all such expressions of opinion can at best be drawn on for a short-term forecast of the political weather from week to week. The real causes of the prevailing climate lie deeper. They are too complex to be expressed in any ready-made formula. Present relations between the United States and Western Europe are complicated by psychological and practical difficulties in both the political and the economic field, though it is not the major political decisions and principles which play the leading part. Both sides agree in principle that the United States is hatching no sinister plans for world conquest or preparing unpleasant surprises for Europe, but that, on the contrary, self-preservation demands that it come to the aid of the Old Continent. Thus it is not the main outline, but the methods, over which Europe and America occasionally get in each other's hair. And as aviation can no longer be ignored in any branch of international life today, it also enters in good measure into the argument.

The cornucopia of American aid

On the face of it, it is not difficult to understand why an American should feel critical towards Europe. After all, the "wedding of the two continents" has cost him a heap of money, and it is understandable that he should be concerned that his money be suitably used. Without going into detail, it may be recalled that the United States already held out a helping hand after World War I and that since 1941 she has made payment on payment to Europe. Of the total of $49,000,000,000 paid out under the wartime Lend-Lease programme, no less than $36,000,000,000 went to Western Europe, which also swallowed more than two thirds of the early post-war aid (1945–48) totalling $14,500,000,000. Marshall Plan funds (1948 to the end of 1952) and current arms aid have furnished Europe up to date with roughly $27,000,000,000.—When Europeans still grumble about the United States they recall a certain film comedy in which the recipient of charity retorts to his benefactor: "Don't forget it is I who am dependent on you, not you on me!"

Yet arms aid is one of the points to which the strongest criticism is applied on both the European and the American side. For example, the Aircraft Industries Association of America has shown little enthusiasm over the system of off-shore orders, since it argues that they are helping—at the expense of the U.S. taxpayer—to build up industrial rivals. On the other hand, there are certain circles in European industry who maintain bitterly that, though in creating the off-shore system the United States was aiming solely at rebuilding an autonomous European arms industry in the interests of general defence preparedness, in reality they had given European firms little but repair work and have so far granted no production rights for American aircraft (except for the assembly of the F-86K by Fiat).

This discussion is instructive in that it echoes one of the central themes in the European-American controversy: for the opinion is widely held that European discontent is to a large extent due to the feeling of being pushed to the wall by America's super-powerful mass production . . . of being robbed of their own way of life. When

Robert Jungk speaks of the "European's fear of the New World's technical revolution," when he describes the so-called technocracy of the United States as being responsible for the European malaise, he is by no means alone in his opinion.

Is the European afraid of American technocracy?

First of all, is there such a thing as an American technocracy? Literally translated, the term would mean that the American nation is governed by engineering. In reality, however, what the critics of the United States reproach her with is not a worship of engineering but her business empire. The loosely applied word "technocracy" is directed not against inventors and designers—the technical people—but against mass production, which is alleged to sap the moral strength of a nation and entail a "materialistic levelling" of society.

There is no doubt that the tempo of modern mass production and the subordination of man to machine has created feelings of discomfort among many Europeans, feelings which may possibly reach the proportions of fear. However, it is not clear why such fear should concentrate, geographically speaking, on the area between the U.S. East and West coasts. The last three decades have seen a similar industrialization process in the Soviet Union, with a tempo and a ruthlessness scarcely less marked than in the United States. If therefore Europeans had any justification for fearing the effects of foreign mass production, such feelings should logically be directed eastwards as well as westwards.

There are other reasons why this does not add up to sense. For one thing, it would be exaggerated to talk of a uniform standard of living in the United States, which after all comprises 48 different States—the most agriculturally developed of which harvests more agricultural produce than France, while the steel output of another considerably exceeds that of the U.S.S.R. Above all, however, the European is no longer alone in his fear of enslavement by the machine. The same attitude is increasingly making itself felt in America itself, and these feelings are shared by American industry, which—in its usual practical fashion—is already energetically tackling the problem. Significantly the expressions "human relations"and "human engineering" come from the American, not the European, vocabulary.

Human relations? To release the worker from the treadmill and remove the oppressive feeling that he is working only for the milling machine, the pneumatic hammer or the drawing board, he is given the opportunity of indulging his hobbies. Factory managements vie with each other in financing works orchestras, football clubs, swimming pools, stamp clubs. One Californian firm gives a bouquet of flowers to every female worker on her birthday. Another recently set up a marriage guidance office, with an assistance fund for difficult cases.

The concept of human engineering arose from an "accident."—Some years ago a brand-new military aircraft came out of an American factory. Fuselage, wings, tail unit, undercarriage, all were unsurpassed of their kind—the whole was an aerodynamic masterpiece. There was only one snag. It was found that the cabin was nowhere near big enough for the planned four-man crew. Somewhat shocked by the ensuing cost of modification, the U.S. Air Force ordered that in future all aircraft projects should be examined by a team of experts from the Air Research and Development Command, to ensure that they meet the requirements of the men who will have to man them. The first Human Engineering Team was born.

Human engineering, or the adaptation of the machine to the man, covers a wide range of measures concerning everything from the production process to the finished product: oscillation tests to protect the worker at the machine from harmful vibrations, air conditioning and dust control of work rooms, heated pressure suits for pilots, facilitation of aircrew duties through rational grouping of instruments in the aircraft. Ultimately even the design of the passenger cabin, its shape and colour scheme, come under the heading of human engineering.

These are merely a few examples among many. However, the importance of such palliatives should not be over-estimated. Moreover, the whole concept of technocracy, despite its importance in modern life, does not appear to have any major effect on relations between the United States and Europe.

Economic and defence policies

An instructive article by W. Averell Harriman, which appeared in the July 1954 issue of "Foreign Affairs" under the title "Leadership in World Affairs," attributes the worsening of European-American relations to certain inconsistencies in American economic and defence planning.

Faced by the threatening events of 1946 to 1948 (attempted overthrow of Iranian Government, pressure on Greece and Turkey, coup d'état in Czechoslovakia), the United States originally decided on a policy of active military and economic intervention, known as the "Truman Doctrine", a policy "to support free peoples who resist attempted subjugation by armed minorities or by outside pressures."

This policy, which bore good fruit during the Berlin blockade, in the Korea conflict, in the rehabilitation of economically under-developed nations, had been based on the following conditions: increased activity by the American and Allied arms industries, strengthening of the U.S. armed services, a liberal world trade policy.

In 1953 these principles had been abandoned in favour of a policy of economy. The arms tempo was slowed down in the 1953-54 budget, despite the warnings of American military circles and N.A.T.O. chiefs, and the 1954-55 budget showed still further cuts. The authorities had decided to limit defence measures to preparations for a possible atomic war of retaliation, neglecting the tactical equipment and forces which were essential for intervention overseas. As was to be expected, the consequences had not been long in appearing. From 1946 to mid–1953 the United States' armament potential–(steel production etc.) augmented by only 4.5 % annually, while that of the Soviet Union rose by 7 % a year. The results had come to light when America had found herself powerless in the face of the events in Indo-China.

A similar mistake in the economic field had led to abandonment of the assistance policy and the principles of liberal trade. Americans had relied on the automatic functioning of the free market and expected it to produce an economic revival in the free world. "But the market is not doing the job."

Harriman's defence arguments show a remarkable similarity with the articles which Colonel Pierre M. Gallois, of the French Air Force Staff, has been contributing to *Interavia* for some years and in which he has repeatedly drawn attention to the dangers of neglecting the tactical aspects of military power.

And the "exclusiveness" of the U.S. economic policy is not least an object of concern for European air transport, whose Atlantic routes all have to end on the U.S. East Coast, whereas American overseas services operate to all major centres inside the continent of Europe.

This brief survey of the points of discussion beween the United States and Europe should show that the differences are by no means irreconcilable, that there is certainly no cause to dramatize the situation.

The American Aircraft Industry Seen by a Frenchman

BY AIR ENGINEER GENERAL ALBERT PARICAUD, PARIS

The author recently made an official tour of leading U.S. aircraft manufacturing plants. Air Engineer General Albert Paricaud is a former pupil of the Ecole Polytechnique and the Ecole Nationale Supérieure d'Aéronautique. Up to the outbreak of war he was Director of Air Contracts. After the war he was appointed Director General of the Aircraft Industry Office and then served as Director of Aircraft Production from 1948 to 1953. General Paricaud is known both in France and abroad as an expert on the industrial and economic problems of aircraft production.

The Editors.

It may be considered as somewhat presumptuous to try and describe the American aircraft industry after only five weeks of touring the leading airframe manufacturers as a member of a productivity team. However, we feel we can legitimately do so, because the aircraft industries of all countries have followed the same evolution, have encountered the same technical, industrial and economic difficulties and have solved them in basically the same way. Hence it is relatively easy to compare these various industries.

The essential differences are differences of scale, and these become of increasing importance.

Before the war, aeronautical research and production was not very costly, and the average country could design the whole range of aircraft it needed, from the lightest to the heaviest, and produce them in adequate quantity out of its own resources. Since the war the cost of creating a prototype has multiplied 15 to 20 times and of producing an aircraft in quantity by 5 to 8 times, even allowing for currency devaluations. This extremely rapid growth during a period when national incomes have increased relatively slowly means that the average country is reduced to limiting its aeronautical activity to a few categories of aircraft which will be lighter and simpler the lower is the national income.

France, for example, has decided against heavy aircraft and strategic bombers. Even Britain does not make strategic bombers, and other European countries restrict themselves to trainers and fighters.

Alone, in the Western World, the United States can venture into all the fields open to technical progress and seems to know no other limitations but its imagination. The American aircraft industry is therefore essentially characterized by the wealth of resources devoted to scientific research and design on the one hand, and by the size, equipment and production capacity of its factories on the other.

In the following, we shall first go into these two points, then discuss the equally important questions of organization and social climate, and finally attempt to appreciate the results obtained on the productivity level.

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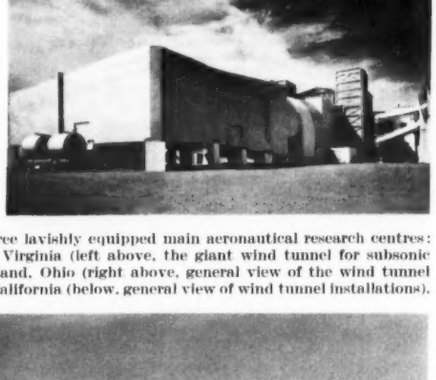
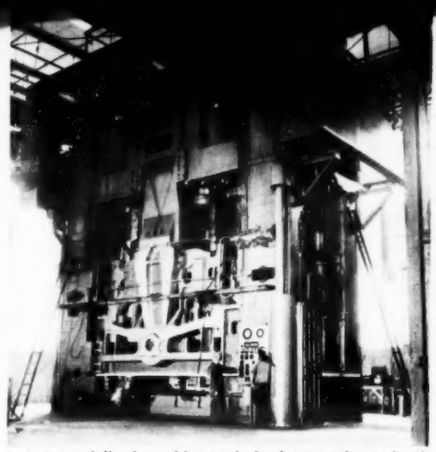
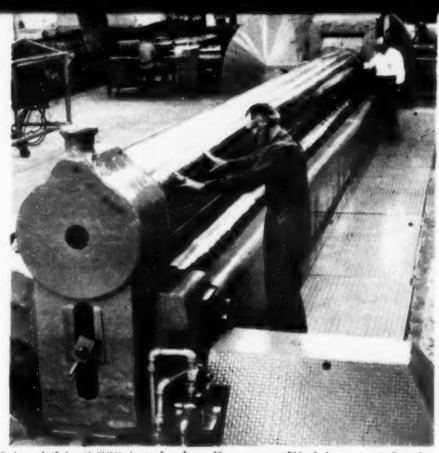


The National Advisory Committee for Aeronautics runs three lavishly equipped main aeronautical research centres: *Langley Memorial Aeronautical Laboratory*, Langley Field, Virginia (left above, the giant wind tunnel for subsonic flows); *Lewis Flight Propulsion Research Laboratory*, Cleveland, Ohio (right above, general view of the wind tunnel installations); *Ames Aeronautical Laboratory*, Moffett Field, California (below, general view of wind tunnel installations).

Scientific research

The Americans believe, correctly, that scientific research is the basis of all productive activity. The chief research organization in the aeronautical field is the National Advisory Committee for Aeronautics. Created in 1915, N.A.C.A. is an independent organization, responsible to the President of the United States and controlled by a committee of 17 members chosen from among personalities interested in aviation. The material and financial resources available to it seem like a dream to European research staffs. It has 27 subcommittees specializing in individual branches of aeronautical engineering and responsible for setting up programmes, and three main research centres: at Langley Field (3,100 persons) for aerodynamics and structures, Ames (1,100 persons) for high-speed aerodynamics, and Lewis (2,500 persons) for propulsion





Latest specialized machine tools for large-scale production are characteristic features of American airframe plants. Left to right: 8,000-ton hydraulic press (Birdsboro) at Lockheed; skin mill for integrally stiffened wing skin panels (Giddings & Lewis) at Lockheed; 200-ton roll at Boeing's plant, for medium-strength skin panels for the Boeing B-47 *Stratojet*.

questions. It also makes use of other research organizations and of universities, to which it makes money grants. Its funds are about $70,000,000, which is roughly eight times as much as is available to France's Office National d'Etudes et Recherches Aéronautiques.

Collaboration between N.A.C.A. and the manufacturers' design offices is very close and very effective. What is more, the manufacturers themselves put considerable sums, up to 3 % of their turnover, into research; this they regard as an insurance against technical aging.

Thanks to this high research activity, the United States takes first place for the quality and originality of its designs. However, the European observer gains the impression that the results obtained do not entirely justify the lavishness of resources and personnel. European countries achieve results which are not greatly inferior at much less expense.

*

The means of production

It is not easy to arrive at the labour force employed in the aircraft industry in various countries, but the following figures for airframe production will give a rough indication: France employs 32,000, Britain 110,000 and the United States 380,000 in this branch. Engine and equipment manufacture each account for roughly an additional 50 % of these figures.

The considerable differences in staff are due to the size of factories, not to their number. A large airframe plant employs approximately 2,000 to 4,000 persons in France, 3,000 to 9,000 in Britain and 25,000 to 35,000 in the United States.

The average American plant is thus today much bigger than the European. This position, which was much less marked before 1940, is the result of the Government's efforts to increase and decentralize aircraft production during the war. Numbers of new factories, which could scarcely be expected to pay their way when peace was restored, were built and equipped by the Government and leased to manufacturers.

In these giant plants it is possible, with good prospects of meeting depreciation charges, to use very large, costly and specialized machines which save a large amount of labour.

The lavishness of the equipment in an American factory is well known. The European engineer is struck by the number and size of the presses, sheet and profile forming tools, milling machines, etc. The United States Government has itself formed a stockpile of very high-power presses, consisting of eight deep drawing presses for 25,000 to 50,000 tons and nine presses for 8,000 to 25,000 tons, which will work for the whole American aircraft industry or even for foreign industries.

As regards special tools and production processes, we saw nothing that was not known in Europe.

One point to note, however, was the tendency to replace components assembled from a variety of small parts by components—wing spars, fuselage bulkheads, skin panels etc.—made in a single piece. Another point is the growing use of metal bonding, which is also expanding in Europe.

*

Organization

The major importance which the Americans attach to the scientific organization of work is well known. A visitor to an American factory is surprised by the number of indirect personnel he meets in the offices, whose task is to prepare and facilitate the work of the directly productive worker, so as to reduce it to a minimum.—Whereas in European firms the indirect personnel is about 70 % of the direct labour force, in the small and medium size plants in the United States it is more than 100 %. However

Modern machine tools at Douglas's Santa Monica plant: this Wheelon Direct Acting Hydraulic Press produces pressures of up to 5,000 p.s.i., and applies a total of 2,500 tons load; it replaces a ten-times larger rubber pad press (cf. the work pieces rear right).

Production inspection is as a rule more thoroughly organized than in Europe. A glimpse into the X-ray test laboratory at Lockheed, where all highly stressed light metal cast parts are examined, without exception.

these plants are larger than ours and frequently work a double shift.

The general organization of American factories does not differ greatly from that of French plants and consists in essentials of:

— Management, administrative and commercial offices
— Engineering
— Tooling
— Manufacturing
— Quality Control.

The points on which American organization is superior are those of collaboration between the various groups concerned in production:

American production quantities are much bigger than French or British: the final fuselage assembly line for the Convair T-29C navigation trainer and Convair C-131A ambulance aircraft at Convair's San Diego, California, plant (General Dynamics Corporation).

a) From the very beginning of design work on a prototype, the design office works in contact with N.A.C.A., who advises them and makes the results of its work available to them. This close collaboration between research and design is one of the main reasons for American technical superiority.

b) When the essential features of the prototype have been settled, the design office continues to collaborate with the groups responsible for preparing and launching production. In many firms the engineering division incorporates the tooling division and the methods office, and its task is not merely to supply drawings but also to decide on tooling and prepare production schedules. Thus design work on quantity production continues at the same time as that on the prototype.

This method is costly, as not all prototypes go into production, but it has the considerable advantage of culminating in the creation of prototypes that are easy to produce in quantity and production of which can be launched without delay.

c) The principles on which the production shops are fed with the necessary supplies are the same as in European plants, but more fully developed. Schedules for the delivery of supplies, the completion of primary parts and of assemblies, are prepared with great precision and very strictly checked. This rigorous planning is essential in view of the high output rate. Its object is to reduce stocks and speed up the production cycle.

d) Finally, special mention should be made of the organization of quality control, which has larger staff and equipment than are found in our factories. Staff engaged on quality control amounts to between 10 and 12.5 % of the total direct labour force, i.e., about 50 % more than in Europe. Another point worthy of note is the close collaboration between Quality Control, Engineering and Manufacturing.

*

The social climate

The social climate in the American industry is both one of the causes and one of the effects of high productivity.

The labour movement is grouped around two large organizations, the American Federation of Labour with eight million members, and the Committee for Industrial Organizations with six million members. The American worker, as is known, has a much higher standard of living than his European colleagues, and his purchasing power is about two or three times as great. The visitor from abroad is always surprised by the relaxed atmosphere in the offices and workshop and by the apparently slow rate of work. Even the bosses seem much less overworked than their European colleagues.

The method of calculating wages does not encourage workers to work fast, for unlike the general rule in France, they are paid not on piece rates but by the hour. This is the only possible method of payment for work on a production line. Moreover, both labour unions and management consider that payment by the hour, though not stimulating to individual effort, has the advantage of creating a general feeling of security and absence of tension that are favourable to general productivity.

*

The results

On the engineering level: American industry is in the forefront of progress. It was the first to create really supersonic experimental aircraft, very-long-range heavy bombers, vertical take-off aircraft, long-range guided missiles etc. . . . and it will probably be the first to put atomic propulsion into practice.

But outside these advanced domains, which other countries frequently have not the means

Quantity production of commercial transports at Douglas's Santa Monica, California, plant.

Quantity production of fighters at Lockheed's Burbank, California, plant.

Quantity production of fighters at North American Aviation's Los Angeles facility.

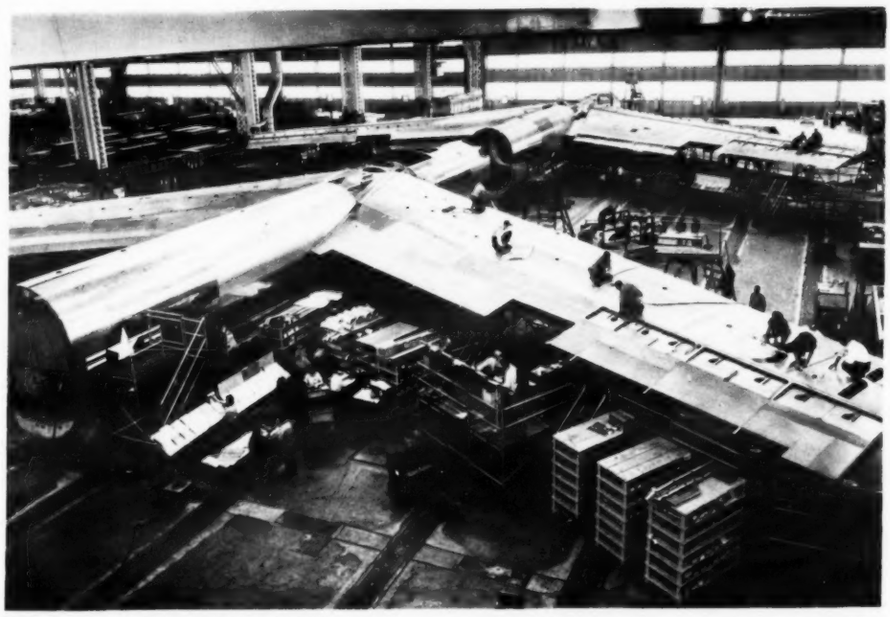
to tackle, American designs are not greatly superior to European.

On the production level: American output is obviously the highest, but are delivery times the best?

In France, we consider that, when quantity production of an aircraft of the interceptor category is launched, the first aircraft will be completed 18 months after receipt of the order, full production is reached about 12 months after the first aircraft, and, once this rate is achieved, each aircraft passes through the whole production cycle in about nine months. These results are obtained with single-shift working.

In the United States, as far as we were able to judge, the first aircraft does not come out much earlier than in France, partly because the Americans do not start production until practically all tooling is completed. Then it takes them only about half as long as it takes us to get into full production and put an aircraft through the production cycle. This is partly due to more extensive planning, but even more to the fact that American firms generally work on more than one shift.

Quantity production of Boeing B-47 *Stratojet* six-jet medium bomber at Boeing's Wichita, Kansas, plant. The 1,000th *Stratojet* (a B-47E) left the Wichita plant on October 14th, 1954. Lockheed and Douglas also build the *Stratojet* under licence.



Production of the Boeing B-52A eight-jet heavy long-range bomber at Boeing's Seattle plant, Washington. View of the preliminary assembly line.

On the question of costs: prices cannot be compared in currency because too many elements are concerned that are foreign to productivity. For example, American wages are about three times as high as French and English wages. Also, French costs include indirect taxes and charges such as social security (45 % of wages) and the output tax (16 % of the selling price), whereas neither American nor British costs have this burden.

We must therefore compare the basic elements in production costs, namely:

a) the number of man-hours needed to produce a given number of aircraft,

b) for each man-hour of direct labour:

— the corresponding number of hours worked by indirect personnel,

— depreciation and consumption of industrial equipment.

As we have mentioned above, the elements under "b" are much heavier in America than in Europe, as the proportion of indirect labour and the amount of machinery are greater. The number of direct man-hours should therefore be much smaller.

But American production series are much larger than the French, by as much as 10 to 1 on a average. It is generally accepted in the aircraft industry that doubling the quantity reduces average time by 20 %. The Americans, with production quantities on an average ten times as great as ours, achieve average times of about half of ours.

Hence the low cost prices which the American industry obtains, despite the high wages it pays, are due essentially to the high output of any given aircraft.

•

The American aircraft industry is that of a large nation of 160 million population, highly industrialized and with a high national income. It can draw upon what seems to us to be almost unlimited resources for research and creation in all the domains open to progress. These keep it a jump ahead, technically, of the rest of the West.

It has large, well organized factories, which work in an excellent social atmosphere and produce in large quantities.

The results it obtains in the matter of technical quality and production output appear to be superior to those obtained in Europe simply because of the superior material and financial resources available to it and the large quantities involved.

The major conclusion to be drawn is the necessity for organizing aircraft production on a European level, thus gathering together design and production resources equivalent to those of the United States.

Editors' Note: W. Stuart Symington, Democratic Senator from Missouri, co-author of the report forming the subject of this article, has long been closely concerned with aeronautics and, in view of the Democratic trend of last month's Congressional elections, can be regarded once again as a "coming man of American aeronautics". Born in Massachusetts on June 26th, 1901, he soon made himself a name as an industry executive and, during World War II, operated the world's largest aircraft armament factory at St. Louis as the President of Emerson Electric Manufacturing Company, which had begun to make power-operated gun turrets. After the war he became Administrator of the War Surplus Property Administration but left this job on January 31st, 1946, upon being appointed Assistant Secretary of War for Air when the Army Air Forces were a part of the War Department. On September 18th, 1947, he became the first Secretary of the now autonomous U.S. Air Force. He was succeeded on April 24th, 1950, by Thomas K. Finletter and assumed the Chairmanship of the National Security Resources Board. He was elected to the Senate in 1952. For many years he has been a persistent advocate, in and out of Congress, of a powerful U.S. Air Force and, more recently, of the immediate development of "intercontinental ballistic missiles fitted with hydrogen warheads."

Senator W. Stuart Symington

U.S. Senators Inspect European Arms Plant

(BRIDGES-SYMINGTON REPORT)

"Good, but expensive. Probably a bad security risk owing to the considerable strength of the Communist parties . . ." These words could sum up the impressions which two leading members of the U.S. Senate, Styles Bridges, Republican, New Hampshire, and W. Stuart Symington, gained during a lightning tour of Europe's defences and Europe's aircraft industry between February 21st and March 6th of this year.

What the two junketing Senators set out to do was this: investigate the progress of the U.S. off-shore procurement programme * and the infiltration into European defence industries by the Communists; and generally to survey the defences of Europe "in this air atomic age." For this purpose they travelled to France, Germany, Italy, the United Kingdom and Spain, interviewed heads of state, visited sixteen production plants and military installations, and conferred with U.S. diplomatic representatives and officials. Their chief concern was to find out what Europe's nations were doing with the vast sums of money the U.S.A. has poured into their industries and defences since the end of the war.

*

Aircraft Contracts and Prices

On May 20th, 1954, the two Senators submitted the report on their trip to the Congress. Their first preoccupation is the state of the off-shore procurement programme.

The value of all contracts placed from the inception of the programme to November 30th, 1953, they state, aggregates $2,219,760,000—nearly all of it in N.A.T.O. member countries; 70% represented purchases of ammunition, aircraft and ships. With some measure of surprise they point out, however, that although it was planned to use from $1,000,000,000 to $1,500,000,000 for new off-shore orders in 1953–54, at the time of their visit not a single new contract had been placed against the funds appropriated in August 1953. To an extent this has been remedied through the award of substantial orders in the past few weeks.

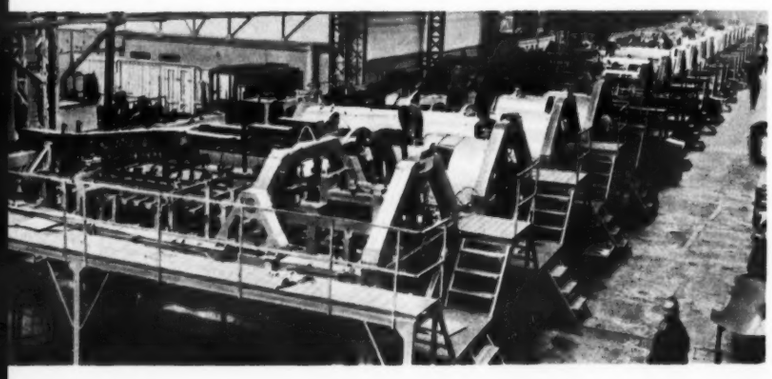
Very soberly the report then spotlights the cost of these contracts. Of interest is the disclosure that contracts for such items as ammunition, etc., may be awarded in Europe at a price of up to 110 percent of prices in the United States, and in certain cases as high as 117 percent. Even these ceilings have been waived in some instances.

Aircraft purchases accounted for about 20 percent of all off-shore contracts, namely, $442,265,000—involving 959 jet fighters (at an overall average cost, inclusive of spares, etc., of about $461,000 each.-Ed.-).

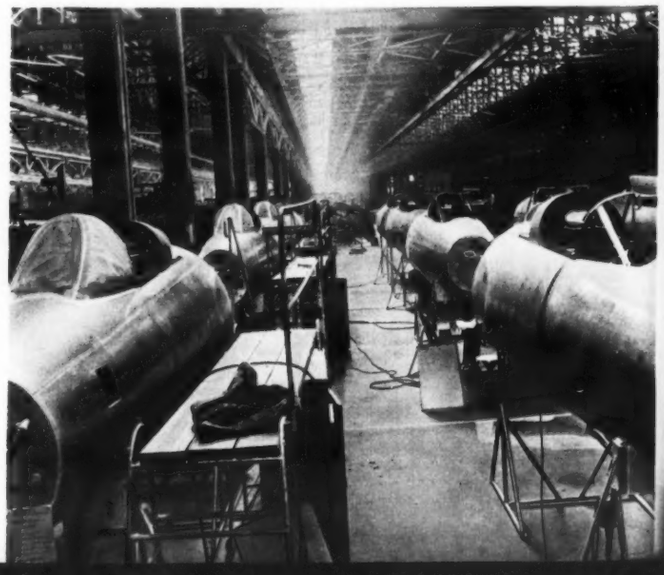
The *United Kingdom* received a contract for 465 Hawker *Hunter* fighters for $140,074,200, including spares, test equipment and training aids; each completed aircraft was to be delivered at a price of $206,970 beginning in March 1955. Almost simultaneously, *Hunters* (complete with spares) were also ordered from the Benelux countries: 64 from *Belgium* for $24,000,000, and 48 from the Netherlands for $18,000,000. Unit price per aircraft in flyaway condition: $234,206—i.e., $27,236 more than the British-built *Hunters*.

* The U.S. off-shore procurement programme was inaugurated during the winter of 1951–52. The objectives of the new U.S. policy of buying military equipment abroad are the following: (1) to establish and maintain a military production base in Europe; (2) to create technical know-how in Europe for the production of military equipment, including aircraft; (3) to enable N.A.T.O. countries to sustain ultimately, with their own funds, the proper maintenance of equipment and also to support their own military commitments; (4) to strengthen the economics of all members of N.A.T.O.

Production line at one of the plants of Avions Marcel Dassault. Workmanship is "far above average", Senators' report says.



Hawker *Hunter* production line at Blackpool.



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The report implies surprise at the discrepancy. There does not seem any reason for this surprise, since licence manufacture is always more expensive. Also, the Benelux contracts are relatively small, which inevitably raises the unit price. Finally, it is no secret that the *Hunter* order had some of the Benelux experts worried because they feared the type might be too complicated to produce in quantity. The two Benelux contracts have aroused certain misgivings among some Air Force officials in Europe, the report says, primarily for strategic reasons.

Headquarters building of the Fiat Company in Turin.

In addition to the *Hunter* contract, the United Kingdom in Spring 1953 received an order for 107 Hawker *Seahawk* naval fighters for $12,810,040, at a unit price of $119,720; deliveries started in June 1953 (which obviously implies that the U.S. is simply paying for aircraft which had previously been ordered for the Royal Navy).

In *France,* the Government has been awarded an off-shore contract for 225 Dassault *Mystère IV* fighters. The contract sum, including spares, is $86,540,000, the unit price of each aircraft $280,000. Delivery was scheduled to start last June.

Italy got a contract for the assembly of 50 North American F-86K *Sabre* fighters for $22,500,000, which includes funds for special tools, ground handling equipment, training devices, etc. In addition to the Italian contract sum, $29,500.000 is to be paid to North American Aviation for the parts being sent to the prime contractor in Italy, the Fiat Company, and also $2,500,000 for two prototypes. Thus, the total sum to be paid for the 50 fighters will be $54,500,000!

"This is an expensive procedure," the Senators' report observes. "It will result in the ultimate cost being greatly in excess of the price for 50 such aircraft in the United States." However, "the stated object of placing this contract in Italy was to revive the aircraft industry of that country."

*

Very thoroughly, the Senators investigated not only contracts placed by the U.S.A. with European manufacturers, but also those American orders awarded to American contractors in Europe.

One of these involved $50,189,757 and was awarded to *Republic Aviation (International),* registered in Switzerland but a subsidiary of the Republic Aviation Corp. It called for the purchase of spare parts for about 669 Republic F-84 *Thunderjet* fighter bombers in service in Europe, nearly all the manufacturing work to be performed in France. This cost-plus-fixed-fee contract allowed a profit of 8½ percent to 10 percent.

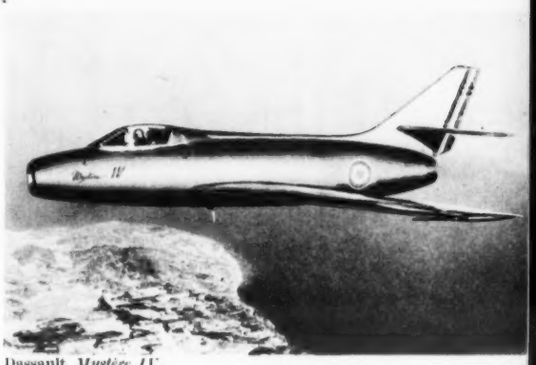
The second was concluded with a subsidiary of Curtiss Wright Corporation, *Curtiss-Wright (Europe),* registered in the Netherlands. It is for about $27,000,000 and provides for the delivery of sufficient spare parts for 340 overhauls and 944 maintenance periods of Wright J-65 engines in the *Thunderjets,* as well as for a rotating stock of J-65 engines. Again the allowed profit is 8½ percent, but the parent company is also to be paid $451,181 for general and administrative expenses.

The two contracts were concluded only after prolonged discussions over the amount of allowable profits, the report says.

Production Rates and Workmanship

It is amazing what the two members of the U.S. Senate were able to accomplish in their tour of fourteen days—which included the voyage to and from the U.S.A. Not only did they study the cost of off-shore procurement in Europe, but they also examined production rates, factory organization and workmanship.

In *France* they found that the Dassault company's plants could reach a *potential* production capacity of 200 aircraft a month, though only 225 *Mystère IV's* have been ordered. Present tooling, however, is adequate to support a schedule of only 50 to 75 fighter airframes a month, with not more than 30 percent of the component parts subcontracted. But, the report says, the *Mystère IV* is not designed for high production, and it is estimated that a maximum of 40 aircraft per month could be produced.



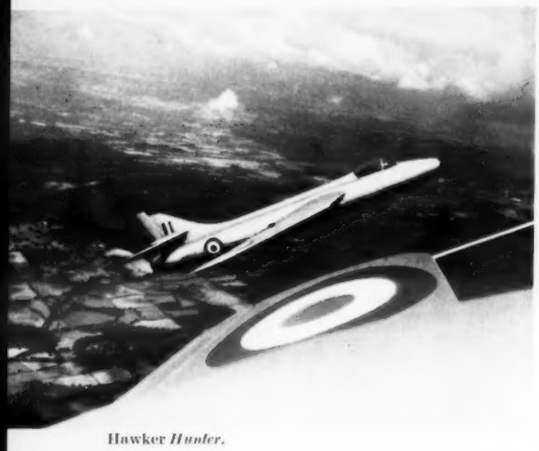
Dassault *Mystère IV.*

Workmanship at the Dassault plants is "far above the average and would compare favourably with the best in the United States." The first production *Mystère IV* was scheduled to come off the production line in June 1954 (it was delivered on June 18th, twelve days ahead of schedule. -Ed.-). It would appear, says the report, that the management, engineering and factory personnel of Avions Dassault are well qualified to handle the order in question.

Of *Britain's* Hawker *Hunter* the two Senators state that the type is designed for a high rate of production. Hawker Aircraft Co., together with its associate companies (probably Gloster and Armstrong Whitworth.-Ed.-) could produce 300 *Hunters* a month. Nevertheless, it is doubtful if the schedule of deliveries to the United States for N.A.T.O. will be met, and it would appear that there will be considerable delay in the planned delivery of the first 25 of the 465 aircraft on order. While the report does not say so, it is known that the *Hunter* is in production also for the R.A.F. and certain non-N.A.T.O. countries, and deliveries have started (the R.A.F. now has two *Hunter* squadrons).

Of Hawker's workmanship, the two Senators state that although exterior surfaces show a high degree of care in assembly and finish, subassembly and production details do not measure up to the standards established by U.S.A.F. inspection in American aircraft plants.

The Aircraft Division of Fiat at Turin. Fiat has enough machine tools to support production of parts "for several thousand planes per month".



Hawker *Hunter*.

All the same, Hawker Aircraft personnel are highly qualified to manufacture aircraft and they compare favourably with American producers. Hawker's tools are modern and all well maintained.

For the assembly of the 50 North American F-86K sabre fighters in *Italy*, the Fiat Company of Turin will employ only about 1,200 people out of its total labour force of 70,000. The company has enough machine tools to support the production of parts for several thousand aircraft per month. Nevertheless, neither Fiat nor any other Italian aircraft company are producing a combat aircraft of Italian design.

The first Italian-assembled F-86K is scheduled for delivery in June 1955. Fiat and North American assert that they will meet this schedule.

R.A.F. Modernization

In a special paragraph the report deals with two aspects of British aviation, namely, the modernization of the Royal Air Force and the much-discussed British Government financial aid to commercial aviation in the U.K.

In 1953 the British Government started an R.A.F. reequipment and expansion programme involving the purchase of Hawker *Hunter* day fighters, Vickers Supermarine *Swift* day fighters and fighter-bombers, Gloster *Javelin* all-weather fighters, English Electric *Canberra* light bombers and the Vickers *Valiant*, Handley Page *Victor* and Avro *Vulcan* medium bombers. The programme was beyond the budgetary resources of the U.K., and the Pentagon therefore decided to contribute to its cost. The fiscal year 1954 contribution amounted to $260,000,000, and additional funds will be made available in fiscal 1955.

In addition to money spent on the modernization of the R.A.F., the British Government also assists in the development of British civil aviation, the report points out. This is done through various types of subsidy, including direct grants to make up for losses incurred by the Government-owned airlines; the purchase of civil aircraft prototypes, and assistance for engine development.

Obviously in order to investigate widespread American criticism to the effect that "U.S. money was being spent by the British for the development of competitive British commercial aircraft," the Senators endeavoured to learn to what extent the British Government had assisted in the development of British commercial airliners; they were told that it was impossible to determine any figure for the period since World War II, chiefly because "military and civil aircraft research and development are inextricably interrelated."

*

Communist Infiltration

The fact which disturbed the Senators more than any other during their tour of Europe was the extent of Communist infiltration in the European arms industry—some of which is producing American equipment under licence.

The two bastions of Communist strength in Western Europe are found in France and Italy. In other parts of free Europe the Communists are relatively unimportant: in Holland they polled 6 percent in the last elections, in Belgium 3 percent, in West Germany 2 percent, in the United Kingdom less than I percent.

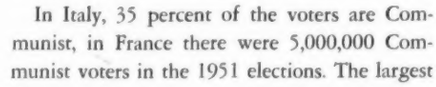
In Italy, 35 percent of the voters are Communist, in France there were 5,000,000 Communist voters in the 1951 elections. The largest labour unions in France and Italy are Communist-dominated. In Turin, for example, 72 percent of the workers employed by Fiat, Italy's greatest industry, are members of the Communist trade union (C.S.I.L.). (At the end of October it was announced that Fiat was screening all employees of its Aviation Division to eliminate members of Communist labour unions. -Ed.-).

*

Conclusions and Recommendations

Summing up, the Senators come to the conclusion that, while some off-shore aircraft contracts awarded to European firms are uneconomical, the production capabilities of aircraft plants in Western Europe are excellent. In some cases, too, profits allowed on some contracts are greater than those allowed American firms for similar products. On the other hand, Communist strength in France and Italy is a grave threat to the stability of Europe.

North American F-86K *Sabre* all-weather fighter, fifty of which are being assembled by Fiat.



They found that the U.S. off-shore procurement programme has resulted in the establishment of a military production base throughout Europe, even though unnecessary delays have occurred in the placing of contracts.

Senators Styles Bridges and Stuart Symington finally submit their *recommendations*. These include:

1. A careful reappraisal of foreign aid should be made before the American people are asked to contribute further.
2. N.A.T.O. countries should be induced to place their own follow-on contracts to keep the production base in operation.
3. Competitive price-bidding should be resorted to in the award of contracts.
4. Profits on off-shore contracts should be carefully regulated.
5. Contracts for standard military items should be substituted for orders calling for classified equipment in areas where Communists dominate the labour unions.
6. Great care should be exercised in the awarding of off-shore contracts to protect the American economy (in other words, contracts for products competing with American products).
7. In the light of the new Spanish construction programme, the air base programmes for Europe and North Africa should be carefully re-examined.

* * *

This travelogue by the two American Senators is not a pure hymn of praise for the Western European countries' efforts to strengthen N.A.T.O.'s defences. Nobody would doubt the sincerity and the wish for objectivity of the authors. Equipped with official data supplied by U.S. diplomatic representatives in Europe, Bridges and Symington embarked on a whirlwind tour of two weeks to gain a picture of the defence set-up of the Old World. They wanted to know how America's defence money was being spent... and they went back disappointed.

The Americans obviously have a growing feeling that Western Europe should now be able to stand on its own feet without massive aid from the U.S.A. Beyond that—and there cannot be any doubt on this score—it seems to be contrary to current American defence policy to award manufacturing licences for up-to-date combat equipment to Europe, at least as long as Communist infiltration into some production plants continues. The Americans will not accept such infiltration, and they even fear its effects.

Aid for the Defence Industry

BY DR. ING. ALFREDO BRUNO, ROME

There are two reasons why Dr. Ing. Alfredo Bruno, former Inspector General of the Italian Air Force, seemed well placed to represent the European standpoint: he is President of the Italian Aircraft Industries Association, Rome, and simultaneously President of the Association Internationale des Constructeurs de Matériel Aéronautique, which unites the aircraft industries of nine Western European countries.

If United States Senator Symington today opposes the grant of licences for modern American equipment, General Bruno's remarks may perhaps encourage certain United States circles, including former Air Force Secretary Symington, to revise their policy in due time. *The Editors*

Not so long ago it was announced that the American aircraft industry had become one of the biggest employers of labour in the country, with a total working complement of more than 800,000, and that its average monthly output is around 1,200 aircraft, of which nearly 1,000 are for military uses.

What is the position in the European aircraft industry? Leaving aside Britain, who, although she belongs to the Western European Union now being formed, has chiefly non-European tasks to perform, the manufacturing capacity of the Brussels Treaty partners stands in the ratio of about 1 : 12 to that of the United States. In other words, its capacity is only about 8 % of the American, not counting any future contribution by Germany.

At the moment, therefore, the American industry has absolutely no reason to fear European competition. Yet it seems that it does. Commenting in 1952 on the off-shore procurement programme, Admiral DeWitt C. Ramsey, President of the Aircraft Industries Association of America, stated that, while he recognized the military necessity for the programme, he could not welcome it without certain reserves:

"The United States aircraft industry has been called upon to cooperate in this programme by turning over to its European Allies some of its basic trade secrets, classified technical information and fundamental patents. In addition . . . this nation's plane builders have been asked for assistance and advice in training personnel . . .

"Granted the necessity for off-shore procurement . . . it would seem logical that the problem be approached through channels which offer . . . the maximum protection to companies whose proprietary rights are involved . . .

"As European production sources are created, design and development work must progress in America in order to assure continued superiority of our military weapons. Extreme importance should be attached, in this industry's view, to the health of the competitive economic system . . ."

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Although Admiral Ramsey may be conceded to have had some cause for concern, it is hardly likely that the modest capacity of the European aircraft industry could form a serious threat to American supremacy in this field. The off-shore procurement programme, initiated by President Truman and the United States Congress, was basically aimed at enabling manufacturers and workers to become more and more familiar with the production of specialized armament equipment and at building up the defence industry's capacity in the North Atlantic Treaty countries.

In the common interest N.A.T.O. decided on a standardization of general armament equipment (in particular weapons and ammunition), whether for training or operational purposes. Would it not therefore have been logical to organize the licence production of up-to-date American aircraft in Europe? Naturally this situation would have to be approached gradually, in view of the present acute shortage of efficient manufacturing plant.

There is, of course, no direct proof that the American industry's anxieties of two years ago have had any effect on the actual placing of off-shore orders. Nevertheless it is true that almost the only aircraft ordered under this programme have been *fighters of British and French design* (*Swift, Hunter, Venom, Mystère*)- admittedly aircraft of high quality. On the other hand, production of American flying equipment in Europe has been limited to minor component assembly and the manufacture of spares for airframes and engines.

There is one exception, however, and it concerns Italy. When the *Venom* became outdated by technical and military advances and was succeeded by the *Javelin* (also a British design), i.e., by "an unproven experimental type," and after considerable time had gone by, it was decided to give Italy a *substitute off-shore order for North American F-86K Sabre fighters.* But even this modest order is to be completed in two stages: initially only final assembly of the fighter from American-made parts will be permitted; production of complete airframes is not scheduled until later. The jet engines for these aircraft (General Electric J-47) will not, however, be built in Italy.

The official reason for the "precaution" of starting off licence production of the F-86K with simple assembly work is the necessity of working up gradually to such complicated manufacturing processes. However, the postponement of the production of complete airframes to a noticeably late date seems to suggest that American planners may have been influenced not only by the press campaign against the licence production of American high-performance fighters by a "politically suspect labour force," but also by some of the above-mentioned arguments of the American industry.

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As everybody knows, arms aid deliveries to Europe are made in two basically different forms: 1—so-called "*end items*," i.e., complete armament items provided free of charge: 2—items ordered under *off-shore contracts* placed

Drawing of the new G. 91 ground attack aircraft made by Fiat, Turin (Bristol *Orpheus* turbojet of 5,000 lbs. static thrust).

with European industry and paid for by the American taxpayer but delivered to non-American N.A.T.O. forces. Understandably enough, American industrialists have not exactly regarded the off-shore programme with pleasure and would have preferred the whole of arms aid to be made in the form of end items.

In our opinion, however, the question is one of proportion. What real difference can it make to the American industry if, for example, off-shore orders for aircraft and other aeronautical equipment to a total value of roughly $103,000,000 went to Europe (including Britain) in the 1953–54 budget year? During the same period the American industry turned out aeronautical equipment to the value of at least $8,000,000,000.—Even if the yearly average of off-shore orders (since 1952) should exceed 1.3 % of the American output, this would still be only a very modest fraction.

On the European side the policy of end items, though detrimental to national industrial interests, has been welcomed by most governments, as they see in it a means of reducing their own arms expenditure.

Drawing of the Aerfer-Ambrosini-Stefanutti *Sagittario II* interceptor fighter (Rolls-Royce *Derwent 9* turbojet of 3,600 lbs. static thrust).

The "invasion" of American flying equipment is, however, by no means restricted to combat aircraft—which would be justifiable from the point of view of defence preparedness. In addition, trainers, transports and even touring aircraft are delivered lock, stock and barrel from the United States, regardless of the fact that Europe's own industry would be quite capable of producing these itself. Is this not a form of "indirect competition" which can certainly not be applauded by the responsible men in the European aircraft industry?

The harm caused in this way is particularly serious in Italy, where public funds are used primarily on the solution of social problems or on reconstruction (at the time of writing civil aviation is excluded from this programme). Freed of the necessity of paying for even basic military training equipment out of its own budget resources, the Italian Government has gratefully accepted all gifts indiscriminately . . . and thus penalized its own defence industry.

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So far the Italian aircraft industry has put up a heroic resistance to this protracted "work of destruction." Despite a crippling lack of orders, it has got together a quite respectable *collection of trainers,* both piston and jet-engined. When a series of trainers from N.A.T.O. countries were demonstrated to experts from the N.A.T.O. Air Training Advisory Group at Villacoublay in July 1954 (cf. *Interavia* No. 9, 1954), Italian designs took an honourable place.

For the immediate future the Italian aircraft industry is planning to *build two types of lightweight fighter,* designed to be fully equal to their military tasks while costing less to produce than conventional models and thus according better with Italy's restricted defence funds. The two types, which are later to be built in quantity, are already in an advanced stage of development. They are Società Aerfer's *Sagittario II interceptor* and Fiat's *G.91 ground support aircraft.*

A development and production programme of this kind, which certainly does not present any form of competition for the American industry, should be encouraged and supported by the competent circles on the other side of the Atlantic . . . if they really wish to keep the European aircraft industry alive and create the nucleus of an independent defence economy for the common defence of the West. Italy's industry could also be developed to take its place in a European autonomy, as Roger Lewis, the United States Assistant Secretary of the Air Force, recognized during his recent tour of Italian aircraft factories. He was impressed by the projects and production efforts of the firms he visited and stated that these achievements were fully equal to those of other countries.

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"Other countries," of course, means other countries in the Western European Union (excluding Britain), particularly *France* with her large aircraft industry and outstanding designs. Other members of the Union are Belgium and Holland, two countries who have succeeded in getting quantity production of modern airframes and engines under way.—From now on, Western European Union will also include the *German Federal Republic,* which will thus put its rich scientific experience, industrial capacity and organizing ability into the common cause. Thus the full technical military autonomy of Western Europe, in the aircraft industry as elsewhere, is now within grasp—hand in hand with a strengthening of the political unity and the common defence front.

Nevertheless Western Europe is still greatly dependent on American aid. Quite apart from funds to carry out European projects and the modernization of production equipment, there is a serious lack of *research and experimental equipment* without which rapid technical progress is impossible. It is in this field in particular that we need continued aid and cooperation from outside.

A first step towards *autonomy of scientific research* will be provided by wind tunnels for high subsonic and supersonic flows now under construction in Holland, and to be available for use by all Western European countries. Another common supersonic tunnel for jet aircraft and guided missiles is also planned, but so far funds are lacking for its construction.

As soon as the countries of Western Europe—in harmony with the political principles of the free world—have achieved economic, technical and industrial autonomy, through honest and rational cooperation, they will be able to repay America in some measure for her support, with valuable suggestions and stimulating ideas. Considering the pioneering work performed by these countries in the past decades, this is no empty promise. Intellectual and practical cooperation between Old and New Worlds will rather strengthen the ability to defend common rights of freedom.

The American industry will always be bigger and more powerful than its European cousin. We Europeans will respect, but not envy it. And our own legitimate development will not stand in the way of American progress.

Conservative Aspects of U.S. Transport Design

Arthur E. Raymond, Vice-President and Director of Engineering of Douglas Aircraft Co., spoke on modern trends in commercial air transport design on the occasion of the 1954 annual meeting of Germany's Society for the Aeronautical Sciences (W.G.L.) at Duisburg.

Nobody can deny that the Americans are today the leaders in industrial production and in the economic application of modern engineering. Whether, historically speaking, they have always been "revolutionaries of technical development," however, is another question. And yet another question is whether "revolution" or "evolution" is to be preferred in technical fields. At any rate, the history of aviation shows that radical innovations have more often come from Europe, while American engineering has been more restrained.

Special mention should be made of Europe's pioneer achievements in air transport, though it is also undeniable that commercial aviation would not have reached its present pre-eminence without the existence of quantity-produced American aircraft. However, such developments as the first European commercial aircraft converted from military types and operated by K.L.M. and the British firm of Air Transport Ltd. (1919), Hugo Junkers' all-metal low-wing monoplanes (1919–33), the Vickers *Viscount* turboprop airliner (1948) and the first jet airliner, the ill-starred de Havilland *Comet* (1949), cannot be overlooked.

In general the Americans have avoided hazardous "assault" operations on new ground and have put all their efforts, their great industrial organization talent and resources, their tenacity, and not least their caution, into winning the decisive battle for markets.

American engineers and industrialists are particularly conservative when it is a question of keeping markets already won, for example the commercial transport market, six sevenths of which is in American hands according to figures published by the Aircraft Industries Association of America. This conservative attitude to airliner design is most clearly personified by *Douglas Aircraft Company, while Boeing Airplane Company* occasionally seems to be more susceptible to "revolutionary tendencies," as witness their early transition to high wing loadings and their construction of the first American jet transport. As for *Lockheed Aircraft Corporation*, the third big aircraft manufacturer on the U.S. West Coast, it is difficult to reduce their development and production principles for commercial aircraft to any similarly brief formula, though they show the same tendency towards constant development as Douglas, which has led from the L-49 to the L-1049G. It should, however, be stressed that what is under consideration here is purely commercial aircraft design. In the military field and in the construction of experimental types, all three firms vie with each other in progressive ideas.

European pioneering feats: On July 18th, 1948, the prototype of the Vickers *Viscount* turboprop airliner took off for its maiden flight.

European pioneering feats: On July 27th, 1949, the first jet-propelled civil airliner, the de Havilland *Comet* accomplished its first flight.

Some of the Duisburg guests listening to A. E. Raymond's address: *Front row, left to right:* Professor M. Roy (O.N.E.R.A., Paris); Professor Theodore von Karman (A.G.A.R.D., Paris); Dr. Treibel; Professor H. Koppe (Brunswick Institute of Technology); Professor A. W. Quick (German Aeronautical Research Institute, D.V.L.); Under-Secretary of State Professor L. Brandt (Transport Ministry, North Rhine-Westphalia); Professor G. Madelung (Stuttgart Institute of Technology).

Latest member of the successful Douglas airliner family is the DC-7, powered by four Wright R-3350 *Turbo-Cyclone* compound engines. The type carries 60 to 95 passengers. A DC-7D turboprop version (four Rolls-Royce Rb. 109 s?) is in preparation.

As long ago as 1935, *Donald W. Douglas* said, on accepting the Collier Trophy which he was awarded for his work on the twin-engined DC-2 and DC-3 airliners: *"There is nothing revolutionary in the airplane business. It's just a matter of development . . ."* Exactly the same view has just been expressed—nearly twenty years later—by *Arthur E. Raymond*, Vice President-Engineering of Douglas Aircraft Co. in the paper entitled *"Turbine Transports, Whither Hence?"* which he read to the 1954 Meeting of the German "Wissenschaftliche Gesellschaft für Luftfahrt" in Duisburg on October 13th, 1954.

*

*Raymond * opened his lecture* with the following remarks:

"It is often said that the only commodity air transportation has to sell is speed. If this were really so, transport aircraft could be rated according to their cruising speed, a very simple figure of merit. The truth is, however, that air transportation is essentially another form of transportation, added to all the others, and an airline must compete with these other forms of transportation and with other airlines, according to the total job that it does, not just one element of that job.

"This job is to carry people and goods to their destination on time according to schedule, safely, surely, and as rapidly as possible, consistent with the rates that can be competitively supported; and, I may add, do so at a profit."

He then went on to examine the various factors which affect air transportation:

Distance: No one would travel by air from one side of town to another, except perhaps in New York, where helicopter services might be used. But the longer the distance concerned, the more likely is air transport to be used and the more important speed becomes to the traveller.

Speed: Although a vital factor in air transportation, its importance varies considerably. Anyone wishing to travel from Panama to Bogota in Colombia will always go by air, since he can then complete the journey in a few hours, instead of days. But he will probably take the first available aircraft, regardless of whether it is fast or slow.

Frequency: Every increase in frequency of a service usually leads to a smaller payload per flight and hence to the use of slower aircraft. A higher frequency, however, cuts down waiting time and thus the total duration of the journey.

Regularity: Cancellations of flights and deviations from the published schedules harm an airline far more than the use of slower but regular aircraft.

Safety: A poor safety record can put any airline and any aircraft type out of business. Safety is always more important than speed.

Comfort: Given comparable regularity and safety on two services, it is frequently comfort which is the deciding factor. Comfort includes seating, low noise and vibration levels, good ventilation and temperature control, appetising meals, efficient passenger and baggage handling, and finally pleasant waiting room accommodation, customs facilities etc.

Rates: The importance of the price factor is illustrated by the growing popularity of the tourist class. Air travel must be as reasonable as possible. Operating costs per route mile provide a measure of how much money an airline will lose during the off season, and the cost per seat mile and per ton mile shows how much it can make during the busy season.

Raymond continued:

"The modern fleets of reciprocating engine transports have reached a very high level of reliability, safety, and comfort, and a low level of operating cost. They have done this as the result of twenty years of development, during which time many evolutionary improvements have taken place in the aircraft, engines and equipment, and in operating procedures, service and maintenance. This result did not spring fully matured from anyone's drafting board, nor will this ever happen with any new type of aircraft. It took the combined efforts and experience of many design, production and operations people focussed on the goal over many millions of hours of flying time.

"I have been in the end of the business directly concerned with design, manufacturing, and field service for all of these twenty years, during which time the company I work for has turned out over 13,000 transports. If

* Arthur E. Raymond was born in Boston, Massachusetts, on March 24th, 1899, graduated from Harvard University in 1920 and gained his Master's degree in aeronautical engineering at Massachusetts Institute of Technology the following year. He also holds an honorary degree of Doctor of Engineering from the Polytechnic Institute of Brooklyn and is a Fellow of the Institute of the Aeronautical Sciences, whose president he was in 1946, a member of the National Academy of Sciences and of the National Advisory Committee for Aeronautics. He joined Douglas in 1925 as a metal worker, then transferred to the engineering department and became Assistant Chief Engineer in 1927, Chief Engineer in 1936 and Vice President in charge of Engineering in 1939, the position he still holds.

there is any one thing we have learned from this experience that stands out above all others, it is that the job is only begun when a new aircraft completes its flight tests . . ."

"It is a common characteristic of scientists that after a new thing has been invented or discovered they tend to lose interest. From then on, they say, the problem is merely one of detail engineering, which is not their business. Similarly it is a common failing of design engineers to start wishing for a new job as soon as the article they have been working on is reduced to practice. But in the world of products there are not one, not two, but three essential steps to success. In the first step, one learns or decides how to do what one wants to do. This is the phase of invention or conception—of research. The second step consists in making a working model. This may not operate very well, or very long, or very consistently, but it does operate, or the project stops right there. The third step is the one called development. This is the one during which the article is perfected—it is made to work right or to work better—and durability and reliability are improved. This third step is absolutely essential to successful air transportation in the true business sense.

"Unfortunately, it is difficult for the large body of mankind to grasp this fact. To many people the mere description of a possible new type of aircraft in a magazine or newspaper is equivalent to its having been built and perfected, and the news of a successful flight or series of flights is abundant evidence that it will be in universal use day after tomorrow. We, who are closer to the airplane picture, know better.

"An airline management is under the imperative necessity of operating an airline and it cannot do so with paper airplanes nor can it do so long with airplanes that are full of troubles. Since all airplanes have troubles to begin with, where and how are the necessary corrections and improvement to take place if this be true?"

The lecturer then examined the following possible solutions to this problem:

— military use of the aircraft or of major components, e.g., power plant;
— thorough flight and accelerated operational testing (also cargo services) before undertaking passenger services;

In the last three years Douglas has spent $ 3,000,000 on project work for the DC-8 jet airliner. Should the company receive a Government contract for a military version of the type, detail engineering and prototype construction could start forthwith.

— no radical short cuts in development, so as to reduce risk.

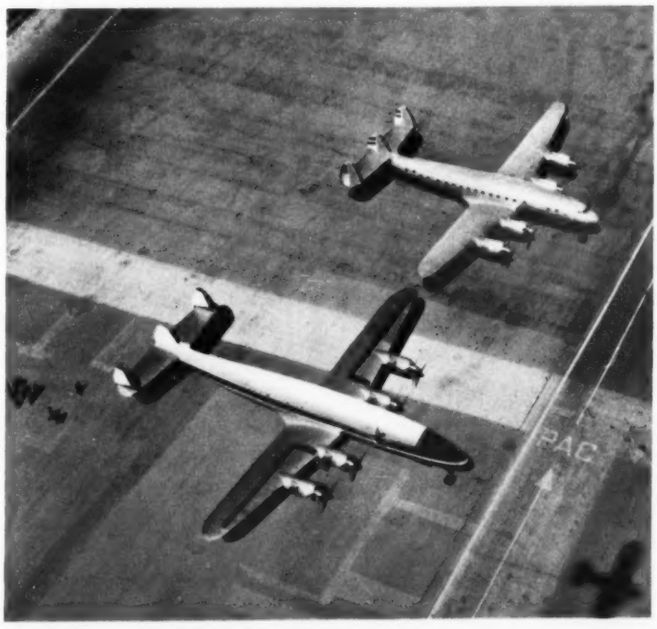
Only "good fundamental and detail design, aimed at avoiding past mistakes" combined with thorough testing of the new type before it is put into service and an efficient service organization, and finally caution in the introduction of innovations can avoid lengthy interruptions in service.

"*When one takes into consideration all that I have been talking about, is it any wonder that the turbine age in commercial aviation has been slow in coming? . . .*"

"Where do we stand now? The pioneer jet transport—a courageous effort—is at least temporarily grounded, the first American design is presently undergoing its maiden flights, one medium-size turboprop is in production and successful service, and a large one is coming along but is not yet in airline use . . ."

"The jet's forte is speed: in this it is pre-eminent. Fuel consumption is high, range and low operating cost are difficult to obtain, and take-off and landing present problems. A large airplane is almost a necessity if it is to pay its way and the resulting thrust output is high, making the outside noise level a serious matter, especially for operations in the vicinity of large cities. This type of aircraft is the most revolutionary of the turbine

Gradual evolution at Lockheed: from *Constellation* to *Super Constellation.*



Gradual evolution at Douglas: from DC-3 (shown is the *Super DC-3*) to the DC-4, DC-6 and DC-7.

types; it must operate most of the time at very high altitudes in order to obtain best economy, where inadvertant depressurization would be mortal. High ambient air temperature and high altitude fields cause serious deterioration in the take-off distance and there are no propellers to be reversed upon landing, so a new device must be developed to produce reverse thrust. The speed increase over present practice is so great that one is working in a different realm of flight. Altogether, one must expect that there will be a very considerable lapse of time before such aircraft are operated in large numbers, many hours per day, and at costs comparable with current ones. Their complete development is going to be a very expensive business and cannot be sustained and supported by any manufacturer or operator without substantial government assistance, either in the form of a military order or otherwise."

"The jet transport is certainly coming; there can be no doubt of that. But the length of time required for it to come is going to be longer than any of us thought two or three years ago. In a size that will pay its way, this kind of airplane will cost from four to five million dollars a copy, which means that its introduction will be slow at best, for financial if not for technical reasons."

Passing on to the less revolutionary *turboprop*, Raymond said that in certain cases and with suitable modifications it can be installed in existing commercial types. However, present-day propeller turbines are not yet sufficiently economical, and operators should wait for the new engines now under development. The extra speed that could be obtained by the immediate conversion of existing transports to turboprop power would not create sufficient demand, but would have to be combined with lower operating costs. Newer propeller turbines have also not yet reached the high degree of operating reliability needed for air transportation.

On Douglas's own plans for future turbine airliners the lecturer said:

"I think we will sometime come out with a turboprop version of the DC-7. We cannot, however, do so until a suitable engine is developed and ready. This engine must have low specific fuel consumption and produce 4,000 to 4,500 horsepower. It must be capable of improving both the cruising speed and the economy of the airplane by from fifteen to twenty percent. Several years must elapse before we have such an engine, and it must of course accumulate many service hours before it could be placed in passenger service."

"If we are successful in obtaining the prerequisite governmental backing in the form of a military order, we will also produce the DC-8. This is a large jet transport on which we have to date spent nearly three million dollars over a period of three years. It has taken us this long and this much money to do the preliminary work necessary before we could be sure that the airplane when built will meet the many requirements laid down for it. Only now are we at the point where shop drawings can be made, material procured, and actual construction started."

The goals aimed at in the design of the DC-8 were given as high cruising speed (around 550 m.p.h.) with a wing of moderate sweep (only 30 degrees) to ensure good low speed qualities; elimination of power-boosted controls for normal flight; sufficient range for non-stop flight across the Atlantic even with powerful head winds (without outboard fuel tanks); satisfactory aero-elastic behaviour of the airframe; suspension of the jet engines in pods; good de-icing; provision for rapid fuelling and pressure refuelling.

Raymond closed with the words:

"I feel very strongly that the progress we make should be true progress in which we advance air transportation as a whole, not performance at the expense of utility, economy at the expense of safety, one factor at the expense of another. If we are to do this our progress along some lines may be slower than some would wish, or might expect, but it will be much surer."

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Strikingly similar views are expressed, more briefly, by a Lockheed spokesman:

"The commercial air transport business is a hard, practical, and highly competitive one and the aircraft manufacturer must produce for the serious consideration of the airline operator an aircraft which practically fits the needs of his business and not be merely a 'glamourous' and 'new' article."

"There is no secrecy attached to the building of a large turboprop transport, but until such time as an airplane of this type can be guaranteed to be more reliable for commercial operation than the piston aircraft now available, there is no reason for opinion to be swayed by the 'newness' of the turboprop as such."

"Lack of experience is not the reason Lockheed has not yet released for production a turboprop or pure jet commercial transport. It is simply that we do not believe the type of engines available today, in either the United States or England, are suitable for large commercial transports of this type. The engines are not considered to be sufficiently developed to a point which makes for a practical economical airplane, which can be manufactured and sold to the world airlines for operation today."

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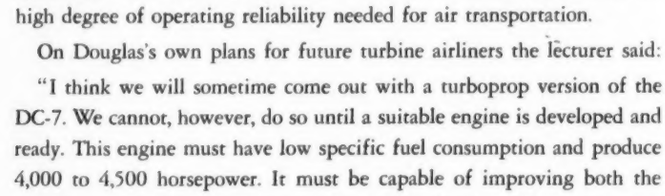
What of Boeing, the least "conservative" of the three, who has brought out the first American jet transport?

Admittedly, theory and practice of the Seattle firm do not altogether fit the subject of this article. The prototype of the 707/717 is now undergoing its second phase of testing and has already reached speeds of 635 m.p.h. and altitudes of more than 42,000 ft. Although the only production order so far officially announced is one for the military tanker version (service designation KC-135) and transport, it is known that Boeing is on the look-out for customers among the airlines (estimated price $4,500,000 each). Therefore it is not impossible that the first civilian *Stratoliners* may be in regular airline service by about 1960. (Design principles of this aircraft were described in detail in *Interavia* No. 10, 1954.)

However, it is certain that Boeing, too, will proceed with the utmost caution in introducing its *Stratoliner* into commercial service.

The prototype of the first U.S. jet transport, the Boeing 707/717 *Stratoliner/Stratotanker* is undergoing its second flight test phase. So far the type has attained cruising speeds of up to 635 m.p.h. at altitudes up to more than 42,000 feet.



Battle for the European Market

BY RALPH L. BELL, DIRECTOR OF SALES
BOEING AIRPLANE COMPANY, SEATTLE, U.S.A.

There were four of us on the trip—George Martin, Boeing Airplane Company's chief engineer: John Yeasting, the company's vice-president in charge of finance; K. J. Luplow, manager of foreign sales; and myself. Our journey to Europe was not a sales trip. We were, instead, bearers of good tidings who were also serving as fact-finders.

This European visit, one of several trips to Europe made each year by Boeing people, took us to the head offices of such airlines as B.O.A.C., Air France, U.A.T., T.A.I., Sabena, K.L.M., Swissair and Lufthansa. The specific reasons for going were: to bring European airline leaders up-to-date information on the progress of flight-testing the Boeing 707, what we had found and what our plans are; to sound out the airlines people on what they considered would be their requirements for jet transports and what performance they would expect in a long-range high speed jet transport; to gain an understanding of the financial problems of the European airlines with respect to dollars; and to look over the competition in Europe for American airplanes.

Americans—like Europeans—take pride in the product of their nation, as well as of their company. We were pleased, therefore, to find a continued high degree of interest in American aircraft, based on the appreciation of businessmen for dependable, money-making equipment. We were even more pleased with the respect European airline leaders have for Boeing products.

The description and performance data we were able to give them for the civil transport version of the Boeing 707 seem to pretty well fit their requirements for a long-range high-speed jet transport. However, as I mentioned earlier, this was not a sales trip; for the time being, Boeing's production of jet transports will be military; we don't know yet how production of commercial jet transports will be sandwiched in with the military commitments.

To our description of the way the new airplane has performed, the European airlines leaders listened with interest. But when it came to engines, they seemed to prefer British to American. Some of the enthusiasm for British engines can no doubt be laid to the strong promotional campaign behind British engines. I believe American engine manufacturers could pretty well neutralize the effect of the British campaign if they were permitted to advertise and publicize their latest engine types; unfortunately, the engines are in military use or are destined for it, and publication of performance and details is restricted.

Some of the interest in British engines can also be traced to the belief that British sources would be nearer, and therefore smaller parts inventories would be required and better service would be forthcoming. As an American salesman, I believe that American firms are prepared to give, and do give, as good service as firms of any other nation. And as far as spares are concerned—in this day of high-speed air freight, no spares depot is much farther than a day away.

Yet another reason for the interest in British engines is due to the dollar situation.

I'm happy that we were able to tell the European airline officials that either the Rolls Royce *Conway* or the Bristol *Olympus*, the engines they seem to like best, could be pod-mounted on the present Boeing jet transport airframe and to assure them that Boeing would be interested in building commercial air liners for foreign lines under such an arrangement.

At Farnborough, where we looked over the latest British aeronautical products, and at the factories of airframe constructors in England, France and The Netherlands, we were able to gain some appreciation of the competition faced by American aircraft manufacturers from new European transport airplane types. We were especially impressed with the de Havilland *Comet 3's* interior arrangement and passenger accommodations. The Bristol *Britannia* gave the appearance of being a good substantial airplane. The Vickers 1000 figures to become a factor in the commercial air transport picture so far in the future it cannot be given worth-while evaluation at this time.

Strictly speaking, from the point of view of Boeing, none of these types is competitive with a transport version of the Boeing 707. The *Comet 3* is a smaller, slower airplane. The *Britannia,* while long-range, is not in the same speed class with transports we are talking about today. At the same time, however, all are or will be competing for a part of the total in money available for the purchase of new airplanes. In this sense, all of these types offer competition.

In Europe there are sales advantages on the side of European aircraft manufacturers. For one thing, their sales forces are within hours of the head offices of European airlines, and the airlines officials can see new airplanes at the home factories by travelling a short distance. This makes it much more convenient for the cross-section of airline management, which must be "sold" before an airplane can be sold, to get the information and impressions they require for their decisions.

Another advantage held by European aircraft constructors is the lower cost for which they can offer their products. This is mainly due to the lower cost of labor.

Still another advantage is in the field of finance. This applies both to the dollar shortage from the point of view of the buyer and to the actual financing of the purchase of airplanes. The European aircraft firms seem prepared to offer terms it is impossible for us to offer. But this is a situation I feel may soon be remedied.

As for the other advantages held by European aircraft constructors in this race for new-aircraft-purchase money, firms in the United States can offset the lower cost of European aircraft by greater sales and production, which takes the greatest advantage of American mass-production methods. Also off-setting the price advantage will be the continued faith of European airline management in the high quality and money-making ability of American airplanes.

Headquarters of the American manufacturers remain thousands of miles away from European markets. The representatives of the American firms make frequent visits to Europe to show graphs and charts and tell the good news about new airplane types. But they are in no position to invite European airline managements over for the afternoon to look at the new transport. On our recent trip, we solved this disadvantage to some extent by carrying with us a fifteen-minute color movie of the Boeing 707, showing its details and giving a short flight demonstration.

Thus we found on our recent European journey that the selling of civil transport aircraft on an international basis continues to be highly competitive. Each firm, each nation has advantages. Each is working to develop products that will sell—and to sell them making full use of the firm or nation's present advantages.

But the race is still on.

A German looks at the U.S.A.

BY SCHOLER BANGS, INTERAVIA, U.S.A.

A German visit to Lockheed. Burbank: left to right: P. K. Yost Jr., Lockheed's Asst. Commercial Director; James E. Boyce (Lockheed); Prof. Leo Brandt; Prof. A. W. Quick (D.V.L.).

To a potential "good customer" the American aircraft industry accorded its full red carpet treatment last month.

Which is to say that in a cyclonic two weeks the Technical Advisory Committee of Deutsche Lufthansa were wined, dined, photographed, walked through plants, gently steered past signs proclaiming "Restricted Area," warmly welcomed into executive offices for quick glimpses of American future transports not yet made public, and literally passed from the hands of one corporate president to the next the breadth of the land.

Pratt & Whitney at East Hartford, Hamilton Standard at Windsor Locks, Sikorsky at Bridgeport. Curtiss-Wright in New Jersey, State Department offices in Washington, research laboratories of Massachusetts Institute of Technology, Boeing in Seattle, California Institute of Technology in Pasadena, Lockheed in Burbank, Douglas at Santa Monica, Convair at San Diego.

Amazingly full of bounce despite the ordeal, Prof. Leo Brandt, director of Lufthansa and chairman of the technical committee, could find no more than half an hour at breakfast in his room at the Beverly Hills Hotel in California to attempt a summary of his initial visit to the United States. Half an hour, once interrupted by the knock of a waiter who evidenced surprise that the hotel's distinguished guest was not yet ready to have his breakfast table removed, finally ended by the telephone's ringing and: "Professor Brandt, the car from Douglas is waiting to take you to the airport."

He shrugged, and smiled with an air of amused resignation.

"You Americans! Everywhere it is the same. You are rushing, always; I believe you say, 'on the go.'"

But during the half hour before the telephone clattered its imperative "time to go, now!" Lufthansa's committee chairman was able to give, if briefly, the reactions of a European to significant influences at work within the United States industry:

"We were interested, the members of Lufthansa's newly-founded technical committee, in gaining first-hand impressions of your manufacturing techniques, your designs for the future.

"I think that all of us will return to our homeland quite overwhelmed by your airplanes rolling down production lines like automobiles, your giant presses, the precision of your manufacturing jigs, the sense of mass production wherever we turned.

"To you Americans it is all quite commonplace, as if it always has been a part of your daily living; and I think that so much stress has been placed upon perfection of your military production that you may overlook your own definite trends of commercial aviation, which become apparent to visitors such as ourselves who are limited to viewing only the commercial aspects of your industry.

"We have been delighted to see on the production line at Lockheed the first of the four *Super Constellations* purchased by our company, and at Convair in San Diego the first (one of four) Convair Liner to display "Deutsche Lufthansa" on its fuselage.

"But I am certain that all of us are convinced that these, among the best available today on any market, are interim airplanes.

"From what I have seen in your factories, and have heard in discussions with your company presidents and engineers, I am convinced that in a very few years you will be supplying the airline markets with pure jet transports. Perhaps sooner than many in the United States seem to realize. Six years has been mentioned by some. I think it may come even earlier; that you may be very close to the time when the airlines will begin conversion to pure jet for their first-class schedules.

"Even earlier, we will see increasing use of turboprop power, and I believe that my committee members will agree with me that the turboprop transport is going to prove to be a very long-lived article. It is not going to be shoved to one side when the pure jets arrive. Rather, I feel that the turboprop airliner will develop its own field and for a long time to come will parallel the pure jet in some instances, and certainly become a standard item for air coach and cargo services.

"I do not feel that these reactions are prejudiced by the rush and excitement of our trip. A visitor to your country, one who has been accorded the intimate hospitality we have received, cannot help but feel that your industry's designs for future transports are much more than interesting drawings. They are given an aspect of solid future reality by the productive ability and prosperity of your manufacturers."

Obviously, it will be to the advantage of the United States industry to have the Lufthansa visitors return with a sense of having seen all that is not "classified."

Seldom has the American industry welcomed as a delegation a group capable of comparable analysis of trends represented by industry leaders. Prof. Brandt, in addition to his Lufthansa affiliation, came as State Secretary to the Ministry of Economics and Transport, North Rhine-Westphalia; Deputy Chairman of the Committee of Transport of the House of States, Federal Republic of Germany, and as a professor of the Technical University of Aachen.

With him as committee members were Prof. Hermann Blenk of Brunswick Technical University, who also is president of the German Society for the Aeronautical Sciences, founded in 1912; Prof. Otto Lutz of Brunswick Technical University, a gas turbine authority as well as holder of patents on the fuel which made possible the performance of the Walter rocket motors developed for German wartime rocket planes and also for submarine use; Prof. August Wilhelm Quick, former Junkers chief of design and now professor at the Technical University of Aachen as well as technical director of the re-established DVL (German Research and Test Institution for Aeronautics); and Gerhard Hoeltje, technical general manager of Deutsche Lufthansa.

To an American aviation observer the presence of such a group raised the question which must have been in the minds of their manufacturing hosts:

"Are you on a shopping trip—for additional planes?"

Prof. Brandt parried.

"We still are awaiting ratification of the peace treaty to permit us to accept, and use, the planes already on order—although I am hopeful that we will receive in advance special permission to commence operations. The Convair Liners are ready and waiting, and the first of our *Super Constellations* will be off the line and ready for flight early in 1955. Beyond these? We still have our financial problems."

World Air Transport is Indivisible

BY SIR WILLIAM P. HILDRED

DIRECTOR GENERAL, INTERNATIONAL AIR TRANSPORT ASSOCIATION

As Director-General of the International Air Transport Association, Sir William P. Hildred looks at air transport on a global scale. As is perfectly understandable from his point of view he stresses initially that there is no basic difference between operations in the Old and the New Worlds: an aircraft is still an aircraft, a pilot a pilot and an air ticket a piece of paper.

The "roots" of the difference lie—he expressly emphasizes—in the geographical, political and economic peculiarities of the two continents, in the large-scale operations in the United States, and the short-stage services in Europe. To remove these differences is the job, not of airlines, but of governments . . .

Hildred is a diplomat—and, what is more, an honest diplomat. At the end of his remarks he describes his own adventures on an air trip from London to Venice. In his usual manner, he is courteous . . . but also quite clear. By describing the differences between a journey of 800 miles in Europe and one of 2,600 miles in the United States, he answers the question which the Editors put to him.

The editor of *Interavia* has asked me to write a brief comparative article, combining the points of view of Americans looking at European air transportation and of Europeans looking at air transportation in America. This is almost an invitation to intellectual schizophrenia.

In his invitation, the editor has suggested that "an article stressing the good and bad points in American air transportation and the good and bad points in European air transportation could form a contribution to the advancement of air carriage in general, inasmuch as it might encourage European carriers to adopt certain American solutions, and vice-versa."

This note could not have come at a more appropriate moment, for I received it in the middle of the 1954 sessions of the I.A.T.A. Traffic Conferences at Venice, one of the peak periods in the year-round activity by which the airlines of all regions of the world are attempting to make perfect air transportation as an international, indeed, a universal public service.

Attendance at successive Conferences over eight years has quite convinced me that we have gone beyond the days when it was possible to talk about American air transportation, European air transportation or any kind of regional air transportation.

Just as "eggs is eggs," wherever you find them, air transportation is one and indivisible over the entire globe. And it must be considered as such by everyone concerned, or it will not realize, as quickly and economically as possible, the full extent of its incredible usefulness to the peoples of any particular part of the world.

As a practical matter, it is impossible to unscramble air transport as it exists today and to tie it up into regional packages. In a physical sense, operators throughout the world are using the aircraft of at most 7 or 8 countries. The skies of Europe are crowded with the planes which roll off the production lines on the U.S. west coast, and by the same token, British aircraft will be taking their place in substantial numbers in American traffic patterns in the near future.

From the point of view of regulation, all these operations and aids are already governed, as they must necessarily be, by the pattern of international rules worked out in the International Civil Aviation Organization—even though the airworthiness certificate or the pilot's licence or the passenger's E/D card may bear the seal of a single State.

Again, when we speak of European air transportation these days, we have to realize that the air carriers of Europe actually do the major part of their business in operations to and through other parts of the world, including the Western Hemisphere. This particularly applies in North America: of the twelve carriers who tap the rich North American traffic market and provide its air connections with Europe, only three are Canadian or American.

By the time one considers the extent to which the airlines of any single continent participate in the traffic of all other continents, regional labels —however tempting it may be to use them— become illegible against the international background of today.

Any one of the 500 or so multilateral resolutions agreed by the 71 Member airlines of I.A.T.A. around the Conference table, at which I am writing this between agenda items, would in itself be ample evidence that air transport must be regarded as universal and cannot be restricted within purely regional or even continental formulae. Later on this week, the same airlines will begin voting on the basic tables of some 30,000 agreed fares and rates for the coming year.

The vast output of the Traffic Conferences thus represents a continuing process by which Americans and Europeans have been watching each other and learning from each other for almost a whole decade since the end of the war. It is by no means the full extent of this effort: the same things have been happening in technical matters (the I.A.T.A. Technical manual is now approximately the size of the Manhattan telephone book); on the financial side; in medicine; in the field of law; and even in public relations.

The whole process has gone a long way beyond the reconciliation of what air transport may have been in Europe and in America before the Atlantic gap was bridged. American operators and European operators, together with their colleagues from other continents, have graduated to a phase in which they are shaping together an entirely international activity.

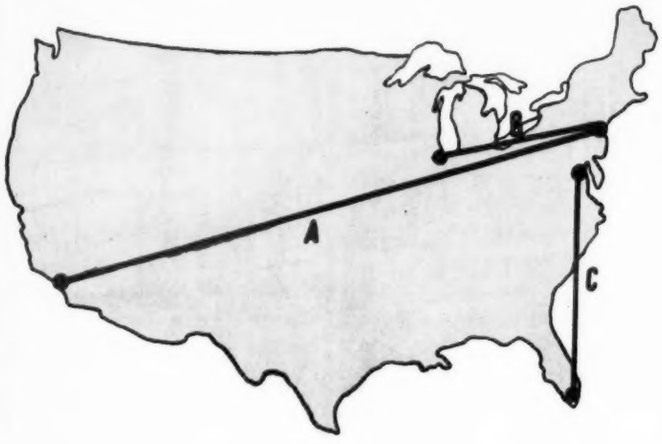
Of course, for all that air transportation and physical media are universal, there remains an America and there remains a Europe. There remain, as well, some differences between the operations which are carried out within the confines of these two continents. However, few if any of these differences stem from the nature of air transport, or from the desires or divergent views of the individual carriers concerned in the localities. Basically, they arise from the different geographical, political and economic characteristics of the two areas.

In the United States, one finds an air transportation system which has been called into being to provide essential communication over a very large area, where major cities are quite widely separated and where few, if any, arbitrary political barriers intervene between them, where only one language is spoken, one currency used and one system of law applied.

In Europe, on the other hand, air transportation is endeavouring to find its niche in a far smaller area whose centres of population are much closer to one another and already served by intensive surface transportation systems. This pocket handkerchief of a continent is carved up, none too neatly, into a score or more of sovereignties, each with its own language, its own laws, its own currency, its own ways of doing business and its own bureaucracy.

It is, therefore, only natural that the air transportation system of the two continents should find problems which are greatly different and which require solutions peculiar to each area.

There may, therefore, be in certain things at least a controversial difference between air transportation in America and Europe. These are differences, however, which do not arise from the nature of air transport itself: rather they are differences which are imposed from without.



Left: three major routes in the United States

No time spent in customs and immigration checks

A: NEW YORK—LOS ANGELES:

2,649 miles; flying time 9 hrs. 20 mins. City centre to airport: New York: 30 mins. Los Angeles: 45 mins.

Fares:	First class		Tourist class	
Single		$158.85	Single	$ 99.00
Round trip		$301.90	Round trip	$198.00

B: NEW YORK—CHICAGO:

724 miles; flying time 3 hrs. 25 mins. City centre to airport: New York: 30 mins. Chicago: 30 mins.

Fares:	First class		Tourist class	
Single		$45.10	Single	$33.00
Round trip		$85.70	Round trip	$66.00

C: WASHINGTON—MIAMI:

1,009 miles; flying time 4 hrs. 15 mins. City centre to airport: Washington: 30 mins. Miami: 30 mins.

Fares:	First class		Tourist class	
Single		$ 63.30	Single	$44.70
Round trip		$120.30	Round trip	$89.40

The old story: U.S. domestic air transport serves widely separated centres between which there are no language, currency, legislative or administrative barriers.—On the other hand, European air transport has to operate in a continent of "vest pocket" size, a mosaic of small countries with different languages, currencies, laws, living standards, business methods and bureaucratic regulations. A comparison between three American and three European major air routes illustrates these differences better than any words.

Right: three major routes in Europe

Considerable delay through customs and immigration formalities

D: PARIS—LONDON:

227 miles; flying time 1 hr. 15 mins. City centre to airport: Paris: 1 hr. 15 mins. London: 1 hr. 25 mins.

Fares:	First class		Tourist class	
Single	ffr.	8,700 ($24.88)	Single	ffr. 7,100 ($20.30)
Round trip	ffr.	15,680 ($44.62)	Round trip	ffr. 12,780 ($36.50)

E: GENEVA—NICE:

180 miles; flying time 1 hr. 25 mins. City centre to airport: Geneva: 35 mins. Nice: 50 mins.

Fares:	First class		Tourist class	
Single	sfr.	146.00 ($33.43)	Single	sfr. 117.00 ($26.79)
Round trip	sfr.	263.00 ($60.23)	Round trip	sfr. 211.00 ($48.32)

F: FRANKFURT—ZURICH:

182 miles; flying time 1 hr. 30 mins. City centre to airport: Frankfurt: 50 mins. Zurich: 60 mins.

Fares:	First class		Tourist class	
Single	DM.	115.00 ($27.20)	Single	DM. 92.00 ($21.70)
Round trip	DM.	207.00 ($49.00)	Round trip	DM. 166.00 ($39.10)

I seriously doubt, however, if the conditions of European air transportation can be brought to a closer and happy resemblance to those of America by any changes in air transportation itself. The changes must come in the political and economic geography of the European continent and they must come, in the final analysis, by the action of European governments.

To get here to Venice from London a week ago, I was forced to change planes twice, to be held incommunicado as a sort of international typhoid carrier by the immigration authorities along the line, to change my money three times (by mathematical processes which I could not hope to understand as a mere layman), to inform three governments of my sex, my age and my marital status (it was presumably not evidence enough that my wife was with me). The route over which I flew was hardly a direct one between any of the main traffic centres at which we touched down, for we were detoured around military danger areas set up without any particular concordance by the authorities of several countries, or routed over national airways which did not quite meet at the international borders.

The flight from London to Venice, which is not a far distance as it is flown by the stateless crow, thus took almost twice the time which is required to fly the far longer stretch across the United States from New York to Los Angeles. For the same reasons, it cost me—and the airlines which carried me—a good deal more per mile than the same amount of air transportation in the United States.

Out of this history of a single air journey within Europe can be drawn quite a long list of specific measures by which the most significant differences between European and American air transportation could be resolved. It is not necessary to set it down here in full: I have already mentioned eggs and I know that the governments of Europe need no instruction in how to suck them. But I might suggest that while eggs are basically the same the world over, some are larger than others and some have larger yolks. I might also note that these differences do not proceed from the nature of the chicken concerned, but rather from differences in their diet, environment, and the methods of raising them. And I might point out that the same thing applies to air transportation.

Observations of International Air Transportation

BY W. A. PATTERSON, PRESIDENT, UNITED AIR LINES

United Air Lines is predominantly a domestic airline. Our 13,500 air route miles extend from New York, Boston, Philadelphia and Washington on the East Coast of the United States, through Chicago to Los Angeles, San Francisco and Seattle on the West Coast. We operate from California across 2,500 miles of the Pacific to Honolulu, but, as Hawaii is a territory of the United States, our long over-water service is still domestic. Our only international route is the 100-mile segment from Seattle to Vancouver, Canada.

Nevertheless, through the New York gateway—as well as through the gateway cities on the Pacific Coast—United Air Lines connects with many international airlines, and thus we have much in common.

I was particularly grateful, therefore, for the privilege of observing trans-Atlantic and intra-European air transportation during a five-weeks' itinerary covering 12,000 air miles.

Travelling with Mr. Robert E. Johnson, United's Vice President and Assistant to the President who has direct responsibility for our Company's sales and public relations activities, I was interested not only in United becoming better acquainted with airline organizations in Europe, but also observing their techniques and practices.

Many areas of similarity with U.S. domestic airlines were apparent, and it was evident that some problems which concern us in our country are plaguing our colleagues in Europe.

The high standard of European airline operation was impressive. In addition to travelling on a number of airlines within Europe (only limitations of time prevented us from covering all), I had the opportunity to visit some of the maintenance bases. It is apparent to me that there is indeed a single, uniform standard of safety throughout that part of international air transportation which I experienced, and, I am sure, throughout the rest as well.

I was impressed with the quality of service to passengers, and while it varied in small ways to reflect the personalities of the different countries, it was all well received. It demonstrated that everywhere the airlines are alert to the need for serving our customers well that they will continue to patronize us and influence others to do so.

Clearly the efforts on the part of the airlines, the airports and the governments to facilitate the complex processing of international air travellers have gained much ground, although further work on improving facilitation will doubtless make this problem much less onerous in the future. Obviously this area is a point of considerable difference from U.S. domestic airline operation, where despite schedule and flight distances as great as 2,800 miles, no barriers of custom or language exist.

I was concerned to see in certain instances comparatively little difference between first-class and tourist intra-European services. Within the United States there is, generally speaking, too little distinction between the amount of service rendered first-class and tourist passengers as compared with the difference in fares, but I found even less distinction on certain European services. It is my own opinion that this trend is unfavorable to the economic welfare of the airlines and needs some attention, although my feeling in part reflects the fact that the basic level of U.S. domestic fares is materially lower than that in Europe.

I found growing concern in Europe similar to that in the United States over the economics of air transportation today and tomorrow. I was pleased to see the accelerating financial problem so effectively underlined by I.A.T.A. President Max Hymans and Director General Sir William Hildred in pointing out that the world airlines had last year been able to retain a profit of only slightly more than one percent on their aggregate gross volume of $2,500,000,000. Surely concentration upon ways and means to reverse this dangerous economic trend is needed on the part of all airlines and their governments.

I returned from this trip with a much better understanding of international air transportation, and certainly a clearer conception of its problems. What I saw served to confirm my already high respect for European airline operation. I brought back pleasant memories of warm hospitality – hospitality which we deeply appreciated – hospitality which exemplifies the fact that airlines the world over cross national boundaries in spirit as well as in fact.

Of all my impressions, the most profound was realization of the airplane's steadily increasing influence in bringing the peoples of the world more closely together—not only in hours and days, but more importantly in mutual understanding.

United Air Lines President William A. Patterson and party on their return to Chicago from a first extensive tour of Europe. Left to right: Robert E. Johnson, Vice-President of U.A.L.; Mrs. Johnson; W. A. Patterson; Mrs. Patterson.

I was impressed with this influence when I sat at the I.A.T.A. conference table in Paris with representatives of the various airlines from scores of countries around the world—working constructively and patiently to insure the sound development of international air transportation's great future.

I was impressed with this influence as I observed the citizens of different countries sitting side by side in airplanes moving so swiftly across the common sky which transcends national borders and languages.

I was impressed with this influence as I saw many different nationals intermingling at the various airports, accepting quite matter-of-factly this relatively new mode of transportation which in truth is a new force in the re-shaping of our social and economic and political lives of the future.

And I was indeed impressed with the common understanding and interests and broad purposes of the aviation officials I met, whether at the various airline capitals I was able to visit, at the Farnborough display, or at the ably conducted Paris general assembly of I.A.T.A.

This basic unity of the airline organizations of the world, surmounting the individual competitive differences which are natural and healthy, argues well indeed for the continued growth and expanding constructive influence of international air transportation.

*

William A. Patterson made his first fairly thorough acquaintance with European air transport in September 1954. He went to Farnborough and on to the I.A.T.A. Meeting in Paris, then visited Switzerland, Germany and other countries. One of the most successful American airline operators, one of the "Big Four", he would have had the right to criticize, even if courtesy bids him to moderation. But apparently he discovered, with some surprise, that we poor benighted Europeans are not so backward after all.

He noticed other things as well. What particularly struck him were the frontier formalities in Europe, the consequent difficulties for airlines and passengers, and the high fares in internal European operations. He considered the meals offered even tourist passengers on European airlines to be too luxurious. He may be right . . . But he overlooks the fact that because of frontier vexations, high prices and crowded seating on tourist services, European airlines must do something to make air travel "palatable" to its customers. He also forgets that there is virtually nothing but tourist class service now in Europe.

Interavia is very pleased to be able to publish Mr. Patterson's remarks and hopes that he will forgive these comments. His words may also be taken as an expression of appreciation to his European colleagues, who did everything in their power to give him, Mrs. Patterson and U.A.L.'s Vice-President a picture of European air transport and to make their stay here an enjoyable one.

Let us hope that the next time he comes to Europe, Mr. Patterson will find that there has already been some relaxation in customs, police and passport formalities, so that his future air trips in Europe will be even more enjoyable.

The Publisher

Airports in the New World

BY L. LESIEUX, PARIS

Born in 1907, Louis Lesieux, graduate of the Ecole Polytechnique and the Ecole Nationale des Ponts-et-Chaussées, worked as a civil engineer for the Ministry of Public Works from 1933 to 1946 and subsequently was appointed Chief Engineer. In 1946 the French Government charged him with the elaboration of a general project and detailed plans for the expansion of Orly Airport, Paris. In November, 1948, he was appointed Director-General of Paris Airport, a post he still holds today. — Thus, since 1948 Louis Lesieux has been called upon to inspect the principal airports of the world and particularly those in America, to study the design, layout and equipment, and to examine airport expansion plans in the process of being implemented.

Editors.

For a European airport manager coming into contact with them for the first time, airports in the United States hold many surprises.

Yet, the overall conception of these airports, their general layout, show no fundamental differences from those of airports in Europe.

It is the operating conditions, both technical and economic, which are essentially different in a country where air transportation has attained its maturity and no longer endeavours to remain distinct from its elders: rail and road transport.

* * *

The main purpose of my first trip, in 1946, was to gather material and information enabling me to work out a preliminary project for Orly Airport, with the development of which I had been entrusted. Therefore I concentrated my studies on the principles which had been followed in America in determining the required number of runways and the general airport layout.

My first astonishment was caused by the volume of traffic at the great airports of New York, Chicago and Washington; at the ease with which the large number of aircraft movements is handled; and at the "output" obtained from the runways.

Installed in the restaurant of Washington National Airport, this renowned gateway to the U.S. capital which even today is an exemplary airport but which eight years ago was regarded as a marvel, I watched aircraft succeeding each other at 20 or 30-second intervals in good weather, saw landings and take-offs on two intersecting runways and discovered the high rate of productivity which had already been attained. In Chicago a few days later, I observed two parallel runways in operation under conditions and with an output vastly different from what were envisaged in Europe, or at least in France.

This is, I believe, one of the most remarkable characteristics of America's airports. It is more than the huge traffic volume—it is the facility with which this volume is tackled under good weather conditions, the ease with which every one of the runways is used to the utmost.

But is it necessary to give one's unqualified admiration to the very great traffic volumes at Chicago's Midway Airport, New York's La Guardia Airport, or Washington's National Airport? I do not think so; in my opinion they surpass what can be regarded as reasonable. The results at Midway Airport, with nearly 800 aircraft movements a day, and at La Guardia, with 600 movements, can be obtained only through minute control of traffic, i.e., through an even spreading-out of all movements, which necessarily translates itself into frequent and, quite often considerable delays, particularly in take-off. Even today this imposes a relatively heavy penalty on the airlines: tomorrow's jet or turboprop airliner will not be able to accept such wastes of time.

The problem of the productivity of the runways in bad weather, under IFR conditions, to use the classical terminology, is much more complex. Two opposing trends of thought were explained to me: on the one hand, a scepticism about the possibility of greatly improving future results in comparison with those already obtained; on the other hand, unbounded optimism proclaiming that very soon—but when?—all problems would be solved and that the rates of landing in bad or good weather would be exactly the same. The latter assumption—obviously the simpler of the

Bus stop and taxi ramp in front of the main building at *La Guardia*, New York's domestic airport.

Central lobby and restaurant at *Washington National Airport*, the world's most modern airport when built and still an example to others.

two—seems to have dominated during the elaboration of general airport layouts. Will the future bear out this optimism? Let us hope so: but I believe nevertheless that it will be wise to prepare to cope with the traffic needs even should the optimistic hypothesis not entirely come true.

While the European engineer must concede a superiority to American airports as regards operation, he will be very surprised to discover that often the runway lengths and clear approaches are much inferior to those encountered in Europe. I shall quote two typical examples.

The instrument runway at La Guardia is only 5,000 feet long. Its boundary, in the direction of IFR landing, is only about 500 feet from a public highway on which traffic is not regulated and which forms an embankment about 10 to 12 feet higher than the runway. At the other extremity, the runway stops about 230 feet short of the low dyke which surrounds the airfield to protect it against high tides. The other runway, the one used most frequently, measures only 6,000 feet and is also framed by the dyke.

The two longest runways at Midway Airport, Chicago, which I believe still to be the "Windy City's" sole civil airport and the busiest of all in the United States, measure only 5,730 and 4,840 feet, the others less than 4,200 feet.

These conditions are exceptional and, incidentally, provisional: it would be unfair not to cite New York International Airport, Idlewild, with its three main runways of 8,000 to 8,200 feet and an as yet unused runway of 9,500 feet, or O'Hare-Chicago International Airport which is to have runways of about 7,900 feet.

But even at modern, recently built airports one can find certain features smaller than what most people consider indispensable in Europe. This applies particularly to the hard strips along the runways proper and to obstacle-free approaches.

Finally, I have not mentioned the equipment of the runways: this is very similar and often identical to that of the various big airports in Europe. However, in Europe greater importance seems to be attached to approach lighting.

* * *

It is a well-known fact that American international air transport is relatively small in comparison to domestic traffic.

In a single case, namely the air services to Canada, the proximity of the country and the competition provided by surface transport compel the airline operators to cut the time wasted on frontier formalities to a minimum, and the necessary steps have been taken.

So far as intercontinental operations are concerned, the problem is obviously much less acute. Here one can, without unduly hampering operations and in any case without prejudice to air transport, apply the full rigours of watertight customs control. It must be admitted that this is being done with much zest. In Europe, criss-crossed with national frontiers, entirely different air transport requirements must be met: and the first thing a man in charge of a European airport must do is to forget all about the operating conditions at American international airports.

America's airports serving domestic airline operations, on the other hand, are of prodigious interest to him.

This does not mean to say that all American airports of today are perfect—quite the contrary. There again one occasionally comes up against installations which would hardly be tolerated in Europe. But the obvious inadequacy of some of them, provisional like those at Midway Airport, old and completely outdated like those at La Guardia, constitutes valuable experience and makes it possible to determine the point of maximum simplicity which can be attained.

One of the first differences to be noted lies in the fact that most cities have no town terminals where the passenger registers his luggage and has his ticket checked. I know that New York is an exception: but New York air traffic is on a level entirely different from European air traffic and therefore is a less pertinent example than other large American cities. Needless to say, the remoteness of an airport from the city always necessitates the creation of a special transport system which, provided that sufficient traffic is available, will consist of frequent shuttle runs not necessarily timed to meet any particular incoming or outgoing aircraft.

I believe that this is a first example we might do well to follow and that this method makes possible a saving of time and a reduction in expenses to the airlines. It has been adopted in several European capitals.

A second, extremely important difference is the use on short and medium stages of aircraft featuring special luggage compartments, such as the Convair 340 or Martin 404. The passenger can therefore take his suitcase along with him. He is not forced to waste time checking it, waiting for it to be trundled out to the aircraft and to be stowed away in holds of awkward shapes, to be unloaded again and delivered to him at destination. The aircraft thus becomes what it really is—a very rapid bus which does not impede its passengers' freedom of action. The airlines, incidentally, are making a point of encouraging their passengers to make use of this facility: "Carry your baggage aboard the Martin Skyliner and save time," or "Save time: carry your baggage on American's Convair" are slogans the passenger meets at the counters of Trans World Airlines or American Airlines. Up to 70 percent of all passengers, I was told in 1953, are using this facility, saving their own time and the airline's money.

Finally, passengers are usually free to go aboard as soon as the cabin is ready, without having to wait until all the other servicing operations are terminated. Needless to say, the aircraft is always brought as close as possible to the gate, unless the parking area is too crowded.

Actually, the best air terminal I know is La Guardia. I am not speaking of the main building or of the principal passenger lobby which, with surprising docility, follows the movements of the capriciously subsiding subsoil: my very good friends of the Port of New York Authority would not forgive me such a eulogy! But I would like to mention one of the off-shoots of the main lobby, a "finger" as it is called in the U.S.A.

At its extremity this finger has a gate on each side. Near each gate is a small, unpretentious desk, with a weighing machine underneath and a notice board above. Two aircraft standings are served by each gate, with the path to be followed by the passenger to the bottom of the aircraft steps traced on the concrete by two lines of paint indicating a kind of corridor.

Prior to penetrating into this finger, the passenger finds, in the main lobby, a reception desk of his airline with checking-in points for several passengers. On the whole, this office is quite small. The passenger, who is usually in a hurry and therefore keeps his suitcase, does not stop there but goes directly to the gate serving his flight. He shows his ticket to the

Idlewild, New York's intercontinental airport, has three main runways 8,000 to 8,200 ft. long and another, not yet in use, 9,500 ft. long.

Passengers at La Guardia pass through the "finger" which juts out into the airfield.

At the end of each "finger" there are two gates, in front of which an airline employee rapidly completes all formalities.

One employee suffices to handle passengers at the gate, since the latter arrive singly, not *en bloc* as in Europe.

only employee (one is enough, since passengers arrive singly and not in batches) and places his suitcase on the scales. The passenger handling official takes down the passenger's name on the list he is making in a single copy—the ultimate simplification of that passenger manifest which many countries in Europe still claim to be indispensable to air transportation. In most cases, the weight of the suitcase is well below the baggage allowance: if there is excess weight, the employee quickly calculates and collects the amount due. With a wide smile he now invites the passenger to follow the path leading to the aircraft. In so doing he takes care to call the traveller by his name, with the deferent cordiality due to a client one intends to satisfy and win over to one's company. At the top of the steps the air hostess welcomes the passenger, without having to indicate the baggage compartment to him: it is right there, directly in front of him, and several pieces of luggage are already deposited. And our passenger will now choose his seat and calmly wait for take-off time, just as if he were travelling by train or bus.

If the passenger arrives a little late, just ten or five minutes before flight time, the officer requests him—again with a cordial smile—to hurry up a little. If he is very late, he reminds him with an even more engaging smile—since he has to scold him—to be a little more punctual next time, and then he accompanies him on the sprint to the aircraft steps which are just about to be removed. If the steps have already been taken away, the officer explains to the passenger—with even greater kindness—that he has missed the flight. And the passenger feels no inclination whatever to complain to the airline management—doesn't he have only himself to blame? Mustn't aircraft leave on time? And when he travels by rail, has he ever observed the stationmaster being handed an advance passenger list? Does the stationmaster ever wait for the last passenger to arrive before he gives the departure signal, or does he give the signal only after all the loudspeakers of the public address system have bawled out the straggler's name to make sure he is not prolonging his tender adieux instead of going up to the gate on time?

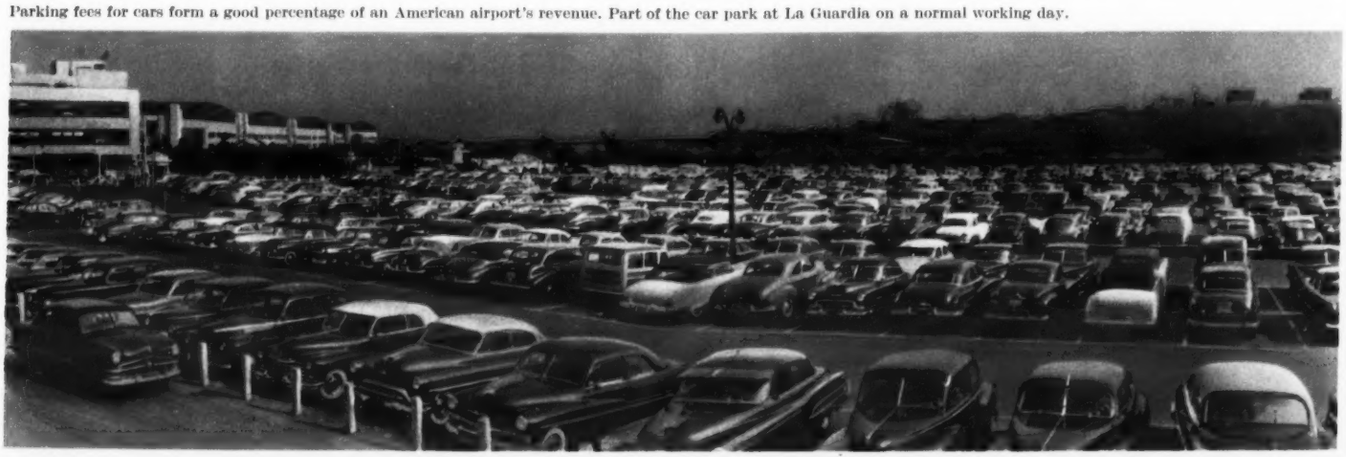
I am exaggerating, of course. Perhaps you will believe that I know the problem of a great airport to be much more complex, and that Orly's air terminal will not consist of a series of little "fingers" of the kind I have just been praising. And also that the employees of American airline companies are not all models of patience, although as a general rule they take very great care in looking after their companies' interests.

Finally, it should be quite clear that I have not been describing the departure of a trans-Atlantic airliner which in many cases will carry several tons of baggage.

But I find it necessary to lay heavy stress on this feature of very great simplicity which characterises short and medium-stage air transport in the U.S.A.—and having to do so is paradoxical. Shouldn't simplicity be the general rule, and is it not normal that air transport should copy what is good in the operations of its elders and competitors, the railroads and bus lines?

But is it not precisely in Europe that we should elaborate simpler and faster operating methods? Since we are saddled with complicated, time-consuming customs controls we should pay all the more attention to

Parking fees for cars form a good percentage of an American airport's revenue. Part of the car park at La Guardia on a normal working day.



speeding up the other formalities. So far the airlines have clamoured chiefly for more speed in customs and police controls. Though progress is still possible in this direction, it should be acknowledged that considerable improvements have already been introduced by these services. It is now up to the airlines to modify their own methods. To be sure, it is not yet possible to deal with the European passenger as the American passenger is dealt with, but the time has come when a beginning of the changeover should be attempted.

Air transport in the United States no longer is a field apart, something quite distinct from the other modes of transport. The same should apply in Europe. Air passengers are not a special race of travellers which the airlines and the customs must continue to treat in a manner entirely different from the treatment of road or rail passengers.

* * *

I have previously underlined the great variety of American airports from the points of view of layout and terminal building design.

The commercial operating results also vary widely, contrary to the view held generally in Europe that American airport managers run their facilities for the sole purpose of increasing receipts. In fact, at one great airport the receipts are mediocre. At many others, the management does not charge admission for visitors or parking fees: receipts are limited to the revenue from the concessions for the restaurant and bar, the newsagent and a few distributors of miscellaneous merchandise.

I have devoted detailed study to the operation of New York International Airport, La Guardia, and Newark Airport, and I cannot see any fundamental difference from the methods used at most airports in Europe. It is the greater traffic volume and, even more so, the discrepancy between American and European standards of living which explain the better commercial returns shown by American airports.

As an example, let us single out the receipts from the automobile parking areas: nothing comparable is possible in Europe at present. A photograph taken of an automobile park in front of La Guardia Airport on any morning is particularly impressive and spotlights the full economic value of the tariff affixed to the watchman's sentry-box. Similarly, every airport collects a fee from the buses running between town and air terminal. Many impose a fee on taxis. Receipts of this sort are not practicable in Europe at the moment or, in any case, would leave only very negligible profits.

Finally, the number, variety and sales of the shops are due chiefly to the big volume of traffic and the relatively high standard of living—as compared with Europe—of all those who go to the airport, passengers, visitors, airline personnel, etc.

List of parking fees on the watchman's sentry-box at La Guardia.

On the other hand, it is remarkable that airports in America succeed in charging an adequate price for the services they render without arousing storms of criticism as is often the case in Europe.

For example, the rents charged for the use of premises built by the airport authorities are always established so as to guarantee a good return on the sums invested, often calculated on the basis of relatively short periods of depreciation. The rents demanded for airline offices naturally vary from one airport to another and also according to location within the airport. But in most cases rents for conventional premises range from $2.50 to $3.50 per square foot (I was even told of $6.00 per square foot for especially well situated offices), i. e., from 10,000 to 15,000 French francs per square metre. Compared with the rates applied in Europe and at any rate in France, these figures are very much higher and contribute largely to making the operation of American airports a commercial success.

Night traffic at Newark, New York's second domestic airport.

A visit to an American airport is of considerable interest to the manager of an airport in Europe.

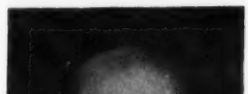
On some of them one finds a traffic intensity and traffic volume which already today are higher than those which can be anticipated in Europe even under the most optimistic hypothesis.

One finds a commercial management which ensures that an adequate and fair price is paid for the services rendered by the airport and which promotes all the ancillary activities made possible and profitable by a high living standard.

One finds, chief of all, an air transport system which has reached maturity, is accepted by everyone, operated with maximum simplicity, and has become a mode of transport like the others but with the added advantage of very much greater speed. This is, I believe, the highest praise one can give and the fundamental cause of its rapid development. It will be necessary to introduce similar conditions in Europe as soon as possible – but the initiative for the change should be taken by the airlines rather than by the airports.

Finally, while considerable differences exist between American airports, there is one aspect in which they are all identical: the manager of a European airport is welcomed everywhere with great cordiality, shown around and briefed in every detail. Those who received me are too numerous to mention here, but I do owe a special mention to my friends of the Port of New York Authority.

My sincere thanks to all of them!



American Avionics

BY E. GUIGONIS
MANAGER OF COMPAGNIE FRANÇAISE THOMSON-HOUSTON, PARIS

Edouard Guigonis, Engineer of the Ecole Supérieure d'Electricité, Paris, and Master of Science of the Carnegie Institute of Technology, Pittsburgh, was born in 1915 and entered the Ecole Navale in 1933. Though a regular officer in the French Navy, Guigonis early showed a marked preference for flying and electronics. From 1944 to 1946 he was a member of the French Naval Mission in the United States, but retired from the Navy in 1948 to take over the management of the High Frequency Engineering Division of Compagnie Française Thomson-Houston, at a time whem this domain began to develop at an unforeseen rate.
Editors

The English language, especially when coloured with a certain American accent, has a special facility for forming the new words needed by today's technical advances. At times these words meet such a precise need that they are immediately accepted in the international vocabulary, despite the criticisms levelled against them, on account of their unorthodox formation, by the purists of various tongues.

The most recent of these star words is used in the title to this article. "Avionics" was born only a few years ago, apparently of "Aviation Week's" need to shorten the heading of the feature it devotes to the application of electronics to aviaction. Thus an editor's "brain wave," arising from the growing importance of a subject that had become a regular feature in the magazine, gave its name to a new industry.

The creation of this industry was presided over by aviation and electronics, and it is therefore not surprising that it should develop in the country where these two branches have made most progress: before coining the word, America had already created the field it describes. The tremendous demand for electronic equipment and the existence of powerful resources there have accelerated an evolution which was in any case inescapable. Hence the problems of *American avionics* are of considerable interest to Europeans, since they prefigure those which sooner or later will confront *European avionics* in one form or another.

First of all, what is avionics? If the word covers merely the application of electronics to aviation, why not consider it solely as a special branch of the latter industry?

This could, in fact, be applied to a whole section of the avionics industry whose role is to supply parts, components, sub-assemblies and even full equipment specially designed for aviation but produced by the normal electronics industry. Here it is purely a question of technical and technological specialization necessitated by the very special conditions of employment of the equipment in question.

These conditions are undoubtedly the most severe ever imposed on electronic equipment. Size and weight must be reduced to the minimum, and equipment must be virtually 100 % reliable in operation, despite shock, accelerations, vibrations, altitude effects. Strict enough in piloted aircraft, these requirements become even more severe in guided missiles, whose performance does not have to allow for human physical limitations.

Within this very restricted bulk and weight, the power required to obtain radio-electric performance to match the aerodynamic characteristics of the vehicle remains considerable. Not the smallest problem here is the disposal of unwanted heat. The equipment must therefore be able to withstand higher and higher internal temperatures, making use of the continuous progress achieved in the technology of the individual parts.

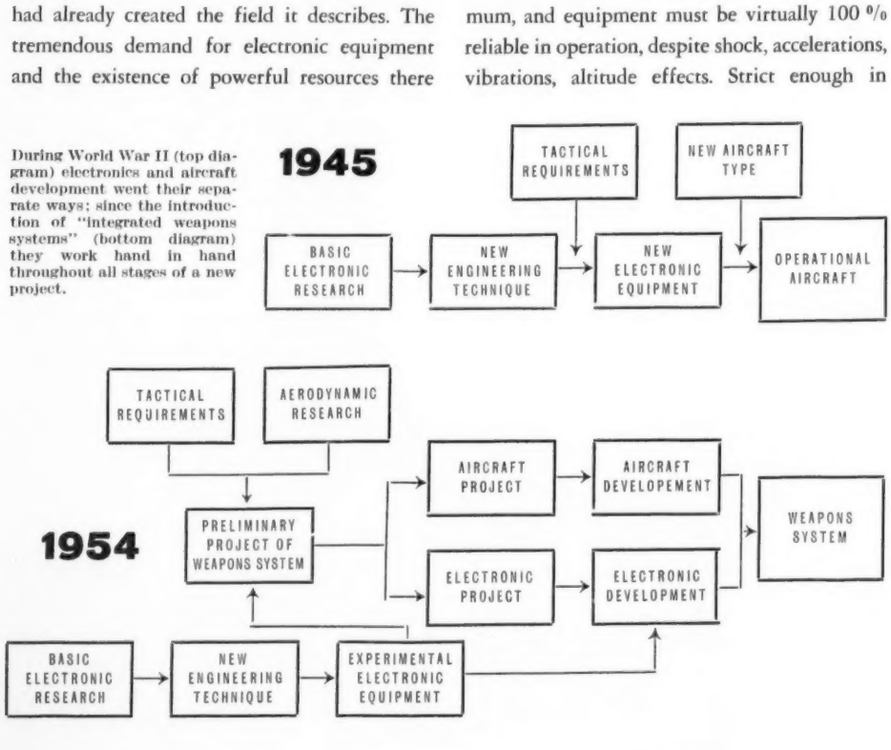
Though they can never be regarded as finally satisfactory, the results obtained are already impressive. One example is that of vacuum tubes, for long considered one of the weak points in electronic equipment; today, after two years of systematic experiment, it has been possible to arrive at a probable failure rate of 0.1 % (one failure per 1,000 tubes in service simultaneously) during the first 1,000 hours of operation, under practical service conditions in commercial aircraft.

It is clear that production of these special elements is an extensive business, closely linked to aviation since only the aviation market can pay the high prices occasioned by such strict specifications. During the past few years hundreds of firms of all sizes have been established in the United States, some of them extremely highly specialized and entirely devoted to this type of production.

However, there is nothing particularly new in this, and if avionics were limited to this field it would be no more than a new branch, particularly active and technically difficult, of the electronics industry.

But the role of *avionics* is not restricted to providing aircraft designers and aviation in general with this or that servo control, radio equipment, detection or navigation equipment. Its true novelty lies elsewhere.

During the last war, the creation of all new electronic equipment began in the research



During World War II (top diagram) electronics and aircraft development went their separate ways; since the introduction of "integrated weapons systems" (bottom diagram) they work hand in hand throughout all stages of a new project.

laboratories where the basic technical elements were developed. Pulse magnetrons, TR and ATR tubes, new aerial techniques enabled new equipment to be produced. This equipment, mounted with varying degrees of efficiency in combat aircraft, led to such successful efforts as the battle against the V 1, the antisubmarine campaign, the defence of the Anzio beachhead, the radar bombing of Japan.

But as H. R. Oldfield of General Electric Co. recently stated at an airborne electronics congress in Dayton, Ohio, it is no longer permissible to make a weapon by joining up a heterogeneous collection of radar, computers, sights, guns and aircraft. The increasing complexity of aerial warfare and the very high performance it demands necessitate the creation of integrated weapons systems designed to solve a clearly defined military problem.

This "weapons system" concept obviously entails close cooperation between the designer of an aircraft and the designer of its electronic equipment. This cooperation must begin at the very beginning of any work on a new system and continue until final realization of the project. The diagrams reproduced here from "Aviation Week" illustrate graphically the process of development followed until recent years and that now required by the weapons system concept.

A good example of such a weapons system is the fire control system for all-weather fighters, in which the whole assembly of radar, computer, automatic pilot, aircraft and guns forms an indivisible whole in which each element reacts on the others and cannot be designed independently of the others. A system of this kind is found in the tail turret of the Boeing B-47 *Stratojet* (see picture).

It would, however, be wrong to think that the weapons system concept is limited to an aircraft's equipment or, more generally, to the production of complex but independent equipment. Aircraft, missile or station is merely a link in the chain of items employed to resolve a given operational problem. It has to work in conjunction with a system of information, preparation of orders, transmission etc. . . . the whole of which constitutes a "super system" subject in turn to the same demand for coordination between its elements.

A relatively simple example of these super systems is the Volscan, which is designed to ensure a regular flow of arrivals at a busy air base. The problem is to organize arrivals in such a way that each aircraft presents itself for final approach with the minimum time spent in stacking at low altitude. The elements which go to make up the system are: surveillance radar, tracking equipment, computer, the transmission of orders, the automatic pilot in the aircraft. Each of these elements is conditioned by the operational requirements of the whole.

Example of a simple weapons system is the remote-controlled twin gun in the rear of the six-jet Boeing B-47E and RB-47E. Thanks to General Electric's fire control radar, the two unmanned 20-mm cannon can even fire on unseen enemies.

It can be imagined that such a system is a fore-runner of much more complex super systems such as those for controlling tactical air operations or interception by guided missiles or piloted fighters.

In both cases (weapons systems or super systems) it is necessary to create industrial organizations capable of taking into account all aspects of each problem set. Hence was born the avionics industry in the new sense of the term.

Occupying as it did a position astride the aircraft industry and the electronics industry, avionics could recruit its members either from aircraft firms, which were familiar with the needs that had arisen, or from electronics firms, which already had basic experience and the resources to expand their operations to the aviation field, or finally from new firms which set up special organizations solely for this limited object.

In the United States examples are found of all three solutions. North American Aviation has included an Electro Mechanical Engineering Department in its Missile and Control Equipments Division, with about one quarter of the whole division's 4,800 staff.

Westinghouse has formed an Air Arm Division whose sales of $100,000,000 and staff of 4,000 persons indicate its size.

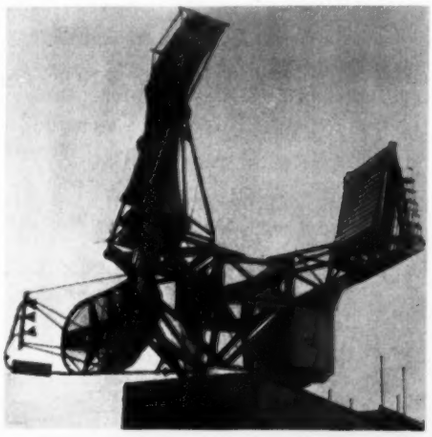
General Electric Co., the extent and variety of whose technical and industrial activities had well prepared it for the new task, has taken a leading position in the avionics of super systems.

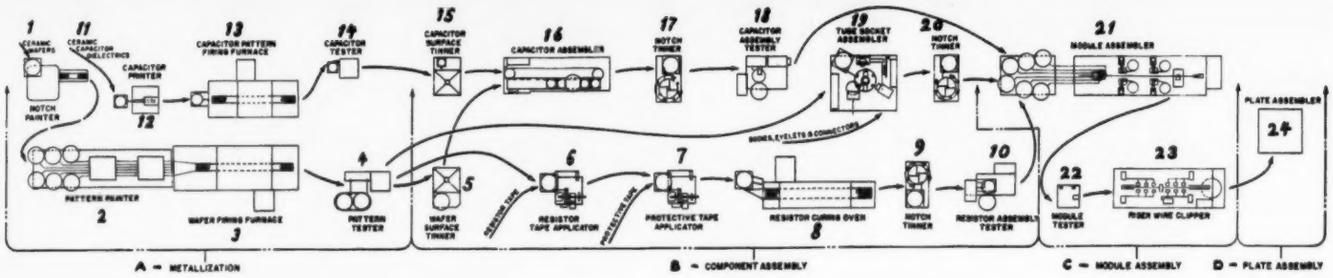
Finally, Hughes Aircraft is a typical example of an aircraft manufacturer switching over almost entirely to avionics.

A few figures will suffice to outline the history of this development and to define it against a truly American background of dynamism and limitless possibilities. The company's sales rose from $1,500,000 in 1947 to more than $200,000,000 in 1953. The labour force working on avionics has increased from 750 in 1948 to 17,000. The research and development division alone employs 4,000 persons, of whom 1,200 hold special diplomas and 120 have doctors' degrees.

Experience has shown that, at any rate in the United States, each of the three solutions is successful. The aircraft manufacturer will have a tendency to concentrate on avionic equipment

An example of a modern "super system" is the American Volscan shown here. Top: antenna array for the surveillance radar, bottom: "pick-up pistol" which the traffic controller holds over the radar blip of a given aircraft and in so doing switches on one of the automatic trackers. A number of automatic trackers and an electronic computer (to determine time of arrival, heading and rate of descent) complete the equipment.





The first fully automatic Tinkertoy plant (Kaiser Electronics Division of Willys Motors) can produce 1,000 modules an hour. (1) ceramic wafers; (2) pattern painter; (3) wafer firing furnace; (4) pattern tester; (5) wafer surface tinner; (6) resister tape applicator; (7) protective tape applicator; (8) resister curing oven; (9) notch tinner; (10) resister assembly tester; (11) ceramic capacitor dielectrics; 1(2) capacitor printer; (13) capacitor pattern firing oven; (14) capacitor tester; (15) capacitor surface tinner; (16) capacitor assembler; (17) notch tinner; (18) capacitor assembly tester; (19) tube socket assembler; (20) notch tinner; (21) module assembler; (22) module tester; (23) riser wire clipper; (24) plate assembler.

for his own aircraft or missile designs. The large electronic firms will be particularly well qualified to produce super systems coordinating a number of basic projects. The independent firms will be able to succeed by tackling certain well-defined problems with the dynamism of their youth (for Hughes this has been the radar fire control system for fighters).

Does this mean that the problem is entirely solved and that American avionics can face without further effort all tasks that will arise? Obviously not.

One difficulty is the recuitment of sufficient qualified engineers. Electronic research already swallows up a great deal of engineering talent, but its more ambitious branch, avionics, needs a particularly rare class of engineer, with knowledge of several branches and capable of coordinating their applications within a complex framework. The difficulty seems to be particularly great in a country where the demand for engineers leads to excessively early specialization among young men.

Then another question arises: will it be possible, in an emergency, to produce the tremendous quantities of equipment which will be needed? Constant technical evolution makes it practically impossible to build up progressive stocks ready for eventual mobilization. The problem would therefore be to produce vast quantities of up-to-date equipment immediately after D day.

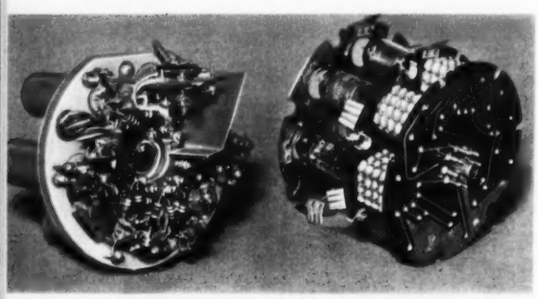
On the whole, the output capacity of the American avionics industry corresponds to current peacetime needs. Strictly speaking, it is not capable of really large-scale production, at any rate not on the American scale. It has, too, to retain sufficient flexibility to make the continual modifications during production and the frequent changes in type of equipment which are necessitated by constant technical development. In view of their complicated nature, it would not be possible to expand these facilities at a moment's notice in order to meet a vastly increased demand. In such a case it would doubtless be essential to call on the resources of the electronic industry, whose vast commercial production capacity (more than $3,000,000,000 a year) could be mobilized for the purpose. But there is so little in common between a domestic television set and an avionic equipment of tomorrow that such mobilization may well supply nothing but so many square feet of factory space and a reserve of labour that is not skilled to avionics standards.

The obvious solution is to mechanize production. Great efforts are now being made in this direction, and certain encouraging results have already been achieved. For example, much has been written about the Tinkertoy Project for completely automatic production of electronic modules consisting of a vacuum tube with its associated circuits printed on ceramic wafers. Assembly of the modules to form either a component or even a full equipment can be done by hand by unskilled labour or by machine. Other similar projects under experiment at various firms, particularly General Electric, illustrate the topicality of the problem.

What conclusions can be drawn from this rapid examination of the American avionics industry, particularly as to what concerns the fate of tomorrow's European avionics? The first lesson is one of modesty and caution. The annual turnover of the American avionics industry exceeds $1,000,000,000. The solutions applicable to so extensive a basis may be useless when reduced to the European scale. We should be particularly wary of the principle of dispersion which the American example seems to advocate. The problems of avionics are so complex that they can only be tackled with powerful resources. The aircraft and electronics industries in the European countries will therefore both benefit if they can arrive at a system of efficient cooperation which avoids dispersion and duplication of effort.

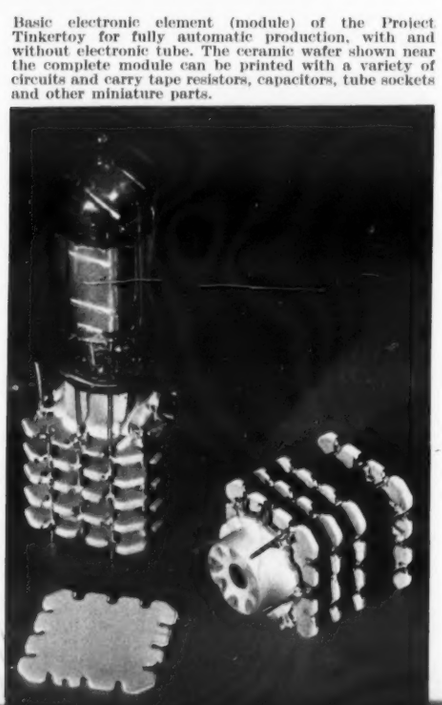
It must also be remembered that in avionics the idea of the "system" is more important than that of an independent item of equipment, and a system cannot be considered purely from the technical point of view. Economic, strategic, and logistic considerations also play an important part. This means that the American system can (and must) differ from the corresponding European system, even when both are designed to meet the same operational problem.

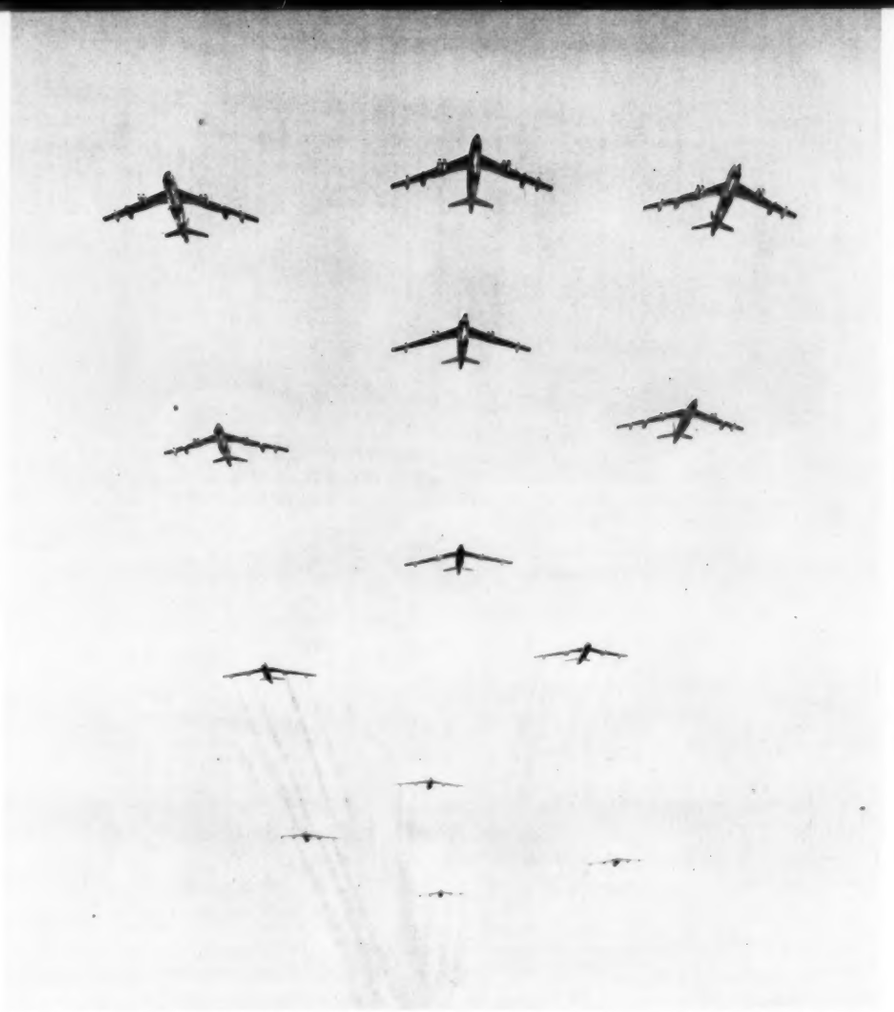
European avionics will have to find its own solutions to the problems confronting it. Undoubtedly it will be able to make use of the irreplaceable basic technical and technological experience accumulated across the Atlantic. But in order to produce systems to meet its own needs, it will have to call upon the creative abilities that are fortunately still very much alive in the Old Continent.



Comparison in size between an electronic submarine warning equipment assembled from Tinkertoy modules (right) and a conventional unit (left).

Basic electronic element (module) of the Project Tinkertoy for fully automatic production, with and without electronic tube. The ceramic wafer shown near the complete module can be printed with a variety of circuits and carry tape resistors, capacitors, tube sockets and other miniature parts.





U.S.A.F., advocate of strategic bombing. These Boeing B-47 *Stratojet* six-engined bombers of Strategic Air Command flew non-stop from England to March Air Force Base, California, in just fifteen hours, refuelling in flight.

The U.S. Air Force — Main Weapon of the West's Defence

Interavia Study Group

With money appropriations four times greater than the combined finance of all the air forces to which it is allied; with three times more military aircraft than all its partners; with a manpower strength double that of all the others; capable, in addition, of supplying about 50 percent of the equipment needed by the Allied air forces and of assisting them both technically and financially, the United States Air Force in itself forms a world which has no possible comparison elsewhere.

It is natural that the European air force specialist should regard this air force somewhat like a country building contractor confronted by the Empire State Building. He will express his admiration, but his appreciation will be tempered by certain criticisms. Lacking enormous strength, Europe has retained a balanced notion of how strength should be measured.

The Boeing B-52 Stratofortress *long-range heavy bomber,* each of whose eight Pratt & Whitney J-57 engines delivers 10,000 lbs. of thrust, is now in production for Strategic Air Command.

This strength was revealed to the world less than fifteen years ago. In a space of twenty months the United States succeeded in setting on foot a fighting force of ten million men equipped with the best arms conceivable at the time. In the same period it had furnished material to its allies to the tune of $47,000,000,000, simply by somewhat stepping up its working tempo and cutting certain domestic supplies.

This new success, characterised by its vast scope and miraculous rapidity, has left its mark on all activities of American life and more particularly on America's armed forces.

Because nothing is impossible, everything is attempted, tested, abandoned, resumed or saved up for later. The formula "it can be done" strains all energies for the attack on what is difficult and often for the conquest of the impossible. The effort is never wasted, for, with the constant improvement of engineering techniques, it will pay off tomorrow what perhaps prematurely had been anticipated for today. The United States alone undertook a programme of research into piloted supersonic flight. And while experimental aircraft of other nations were still probing the sonic barrier, Bell aircraft and Douglas *Skyrockets* cruised around at ease in a speed region still closed to other air forces.

This heritage of achievement, this constant success which pulverizes doubt and silences the timorous, must be regarded in the light of a just geopolitical appreciation if the basis of America's air power is to be diagnosed correctly. Immediately after World War I General "Billy" Mitchell had criticized the narrow conception of military air power then prevailing in Washington. Through the study of geography the fiery advocate of air power came to appreciate the

U.S.A. — Europe

To fulfil its global mission, the U.S.A.F. operates in all latitudes. *Left:* at the geographical North Pole, a specialist records gravitation measurements; *centre:* paratrooper exercises at Fairbanks, Alaska; *right:* under the palms of Randolph AFB, Texas.

missions of an air force and to demand the adoption of the corresponding techniques. As an assistant to the Chief of Staff (1921 to 1925), Mitchell organized the first flight around the world. Long before, he had correctly foreseen the importance to aviation of Alaska, Greenland and Iceland and of trans-Arctic flight. Fifteen years later this global conception of the air arm was the decisive factor in the choice of heavy flying equipment and, five years later, in the establishment of operating plans against Japan and Germany.

The European nations had the doctrines of Douhet. But geography did not permit them to apply a theory whose instruments, furthermore, at the time were far beyond Europe's engineering and economic resources. Apart from Britain, whose isles were protected by the Channel from invasion by ground forces, these nations were unable to choose the air arm for their sole defence. The disadvantage of forming part of the Continent, without natural barriers which would have saved them a hundred divisions, imposed upon them the necessity of maintaining three services and what has come to be known as a "balanced force." To be sure, the same practice was followed in the United States and to a certain extent in Britain, but *on the other side of the Atlantic the possibilities offered by long-range air operations and strategic bombing had dawned upon military thinkers as long ago as 1935*. In Europe, the Spanish civil war had decided the shape of air operations at the beginning of World War II. It was there that the Germans had conceived the idea of the *Stuka* and its operational tactics. The Russians replied with the *Stormovik* and disbanded their strategic air command. For the United States, the Spanish experience had been a local incident, a form of war tied to certain conditions of the theatre of operations and available technical resources. The Boeing B-17, Consolidated B-24 and, later on, the Boeing B-29 were the instruments of long-range attack which progressively destroyed the war potential of the adversary and simultaneously sapped his will to fight. This validity of the thesis was borne out in four years of attack on the Third Reich and Japan, including the two A-bomb raids on the latter country. When the explosion over Hiroshima united the all-powerful nuclear projectile with the strategic air vehicle, it became clear to everyone and particularly to the strategists of the U.S. air arm that *the U.S.A. was now wielding a thunderbolt* and that, with its air force, it could impose peace on the world.

This mission of *policing the world* determined the structure and the composition of U.S. combat aviation. Brusquely, within a few months, World War II had launched the C-47's of Air Transport Command on to all the air routes of the world. From Miami to Rangoon, via Accra and the Persian Gulf, from California to Australia or the Aleutians, hundreds of bases had been created and a network of air transport set up which six years later were to serve the strategic defence of the West. With the exception of Continental Air Command, Air Defense Command and a portion of Strategic Air Command designed to operate from Federal territory, all the U.S.A.F. combat units are equipped as expeditionary forces. "Tropicalized and winterized," U.S.A.F. equipment must be capable of operating in every latitude, because its "*vocation is global.*" Fully equipped and entirely independent of local resources, the American air units sent overseas immediately set about creating conditions resembling those "at home." A certain luxury added to bare necessities, the policy of not procuring anything locally, obviously increases the required travelling kit, and ultimately the actual combat force is supported by an enormous

International routes of the Military Air Transport Service, successor to the wartime U.S.A.F. Air Transport Command. Carrying out its worldwide duties, it transported 700,000 passengers and 89,000 stretcher patients from the beginning of 1953 to the middle of 1954.

There's nothing primitive about U.S.A.F. facilities. Bakers at a U.S.A.F. base in Germany turning out bread, buns, sweet rolls, cakes and pies.

Making oneself at home in every part of the world. Two American servicemen in their quarters at Mildenhall R.A.F. Station, England, in conversation with a British colleague.

"base" of logistic and ancillary services. Still fresh in one's mind are the criticisms that were levelled on this account against the U.S. armed forces in Korea. These criticisms, incidentally, overlooked the fact that firepower must be paid for and that an army, even one engaged in combat, reflects the standard of living of the average citizen. A certain parallel must be established between the standard of living of the soldier (who is, in most cases, a mobilized civilian) and the civilian at home. The "weakness" of the expeditionary force is the lack of tactical adaptation to the peculiar conditions of a given theatre of operations, rather than the price which such a force costs or its unwieldiness which impairs its mobility. A U.S.A.F. wing probably has twice the personnel strength of a Belgian or Italian wing. Chief of all, it is not certain that its equipment would be suitable for a war along the Rhine or the foothills of the Alps. Neither the organization, nor the equipment conceived and built on the other side of the Atlantic, nor the training methods employed in the U.S.A. are necessarily adapted to the geographical and tactical characteristics of a campaign in Korea or Europe. Financial and engineering resources can play an enormous role, but sometimes they are overwhelmed by the elements or by the adversary's conception of the war. But experience in World War II and during the Korean conflict has shown that once the element of surprise has passed, American organization reveals itself to be stronger—however, at the cost of supreme effort and heavy sacrifice.

This *"universalism" of the American air arm,* deeply thought out and purposefully adopted because more than any other country the U.S.A. has realized the global quality of air power, could not be applied to all other air forces. These may be placed in different strategic circumstances; they do not have the same resources; geography imposes other imperatives; the proximity of the potential adversary creates different requirements. In most cases it is a combination of such particular characteristics that spells out the difference. This difference is not always understood even by the U.S.A., which tends to reason by analogy, to judge by its own possibilities and achievements, and to insist on sharing the results of its own experience. In some cases, too, the U.S.A. go very far along the road of self-criticism. At the most difficult time in Korea Mr. *Hanson Baldwin,* the military expert, wrote a piece along the following lines.

The best fighter in the Pacific at the outbreak of World War II was the Japanese Zero. The best fighter in the world at the end of the war was the German Me 262. The British had perfected the Pathfinder technique for night bombing, the first radar interceptor control system and a quantity of other novel ideas. The Whittle jet engine was the first to go into service. The Germans were the first to introduce air-to-air rockets in combat. They were the first to use V. 1 and V. 2 missiles. Their work in the missile field was far advanced and since the war their aeronautical research, the jet engine, the swept wing, the delta wing, etc., has formed the basis of studies conducted in the United States and Russia. Both American and Russian post-war fighters owe much to German wartime conceptions. In the present race for air supremacy we have certain positive advantages. Our heavy bombers are probably as good or better than those of any other nation. But in the fighter field the Russians, with German help, may be our equals or better, at least so far as quality is concerned. Our tactical air forces, designed to operate against enemy ground forces and in close support of our own land forces, have been greatly neglected since the war. As regards their effectiveness, the Soviets' tactical air forces are superior to ours . . .—And the New York Times military commentator concludes: The U.S.A. of

A M.A.T.S. transport flies supplies to Thule Air Force Base, Greenland.

tomorrow will no longer be able to found her security on her mass production. Quantity without quality could lead to catastrophe.

This criticism is severe and only partly justified. It is not the quality of American equipment which falls short: it is, in some particular cases, its adaptation to the tasks it will have to perform. Contradiction is possible between the aim of "aerial universalism" and the multiplicity of different missions required of an air force engaged under every sky and in every kind of circumstance.

Like any industrial or commercial activity, the overall size of the U.S. armed forces—the air arm included—expands or contracts in accordance with requirements. In 1939 the nucleus of the future Air Transport Command consisted of Colonel E.S. Gorrell and two secretaries. In case of national emergency Gorrell was to mobilize two-thirds of the 430 civil transports which formed the bulk of the fleet of the commercial airlines. But two years later the Colonel's successor had under his orders an armada of 2,000 aircraft operated by more than half a million men. Another example: from the manpower point of view, America's aircraft industry in 1944 headed all others in a country of formidable industrial potential. In 1949 it came 44th in the hierarchy of labour forces. The 2,000,000 people which it employed at the end of the war in Europe had shrunk to a mere 160,000. Since then, as a result of the various cold and lukewarm wars, it has put on muscle again.

These wide oscillations are difficult to understand in old Europe. Once it has succeeded in getting on the up-grade, Europe endeavours to maintain the same upward trend at all costs, or at least to continue on the level that has been reached. It has been said that America is in a state of "permanent revolution" and that America herself was an "experiment." This has been true so far as her air arm is concerned. But it seems likely that these expansions and contractions will gradually become less marked, since the combination of long-range aircraft and atomic projectiles constitutes a permanent danger.

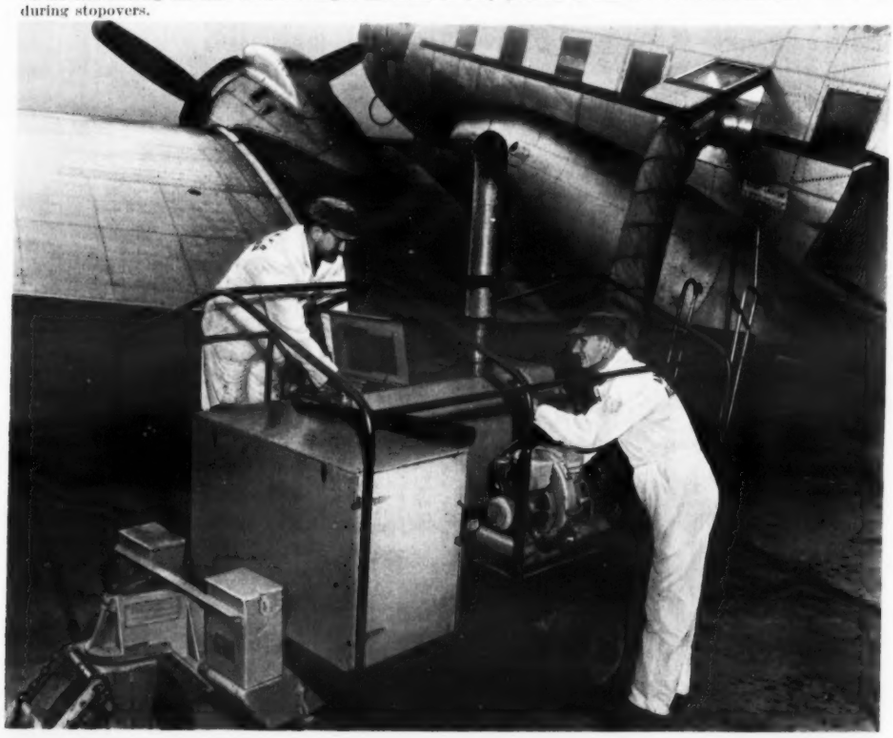
Another characteristic of the American air arm, namely, its huge size achieved by borrowing manpower from civilian life, is gradually on the wane. But even today less than 30 percent of the cadres belong to the regular Air Force and the percentage of officers that have graduated from West Point is very low. Around a slender but solid structure of professional cadres the U.S. Air Force has been built by resorting to "involuntary recalls" of specialists who had returned to civil life. Anything but a call-up of civilians would have been impractical following Pearl Harbour, and "recalls" became necessary after the Korean alarm, when a new long-term expansion plan was adopted. This forcible intermixture of military and civilians had the merit of introducing into military activities the notions of productivity and efficiency which mark the success of commercial enterprises. Contrary to certain European air forces, which for various reasons were not able to mobilise and use civilian resources, the U.S. Air Force has not evolved parallel to but outside of technical and commercial progress. It has never ceased to borrow from the living body of the nation every method and every technique capable of improving its own efficiency. In this respect the policy of "involuntary recall" of reservists is typical, since assignments and ranks are attributed according to the reservists' peacetime activities, with the building contractor being appointed a colonel dealing with infrastructure and the garage proprietor given an equivalent military assignment and rank corresponding to his functions.

The size of the U.S.A.F., its manpower pool and the endeavour to enhance its efficiency have together resulted in a "cult of the specialist." This sharp division of duties, which is also found within the great industrial corporations on the other side of the Atlantic, has become the general rule in the Air Force. Everybody has his place, a place as narrow as possible to make sure that the duties associated with it are performed as fully and competently as possible. The sum of these dove-tailed efforts makes it possible to carry out the prescribed mission without each participant knowing any more than the role he is playing himself. American psychology, the widely held belief in the merit of correctly accomplished duty, the natural discipline of the American people once it forms part of a well-run organization, make possible this all-out specialization which, incidentally, is indispensible owing to the gigantic growth of the U.S.A.F.

The abundance of resources, the urge towards immediate solutions, the specialization of personnel, and the compartmentalization of ideas accentuate the empiricism which is natural to the Anglo-Saxons. It was not a rare occurrence, during the last hostilities, for succeeding command teams arriving at advanced air bases to set up installations in great haste which were immediately demolished or modified by the next team, only to be modified, destroyed or abandoned by a third group in favour of a new solution. Because the American citizen lives in a "permanent revolution," he takes care not to build for the future, but he seeks to obtain immediately what he needs today, even though this may mean that he might have to destroy and rebuild in order to meet the requirements of tomorrow. Our old Europe, more fossilized in continuity, often regards this attitude as hasty and mumbles about wasteful methods.

Chief of all, however, the U.S. Air Force enjoys the support of the people. It guards the security of America and to a certain extent still guarantees the peace of the world. It has even been said that sometimes it must repair the damage done by the politicians and, as in the case of the Berlin Air Lift, save the day for the nation. Encouraged by this confidence, sure of the decisive nature of its mission, *the U.S.A.F. knows that it is the principal weapon of the Western World.*

The influx of civilian mechanics offered great advantage to the U.S.A.F. These two sergeants at Andrews A.F.B. built an aircraft-heating machine from scrounged materials to keep patients in smaller evacuation aircraft comfortable during stopovers.



What's in the Air ? *

AVIATION POLITICS

• Change in Italian Air Force Command

General Aldo Urbani, creator and Chief of Staff of the post-war Italian Air Force, has retired on reaching the normal age limit. At the farewell ceremony in Rome, which was attended by leading American diplomatic and Air Force personalities, including the United States Ambassadress Mrs. Claire Booth Luce, General Urbani was decorated with the American Legion of Merit.

General Urbani has been succeeded by *General Ferdinando Raffaelli*, who has been Commander, Air Defence and Inspector General of the Italian Air Force since 1951. A pilot with 3,000 hours' flying, including 500 hours in war operations, General Raffaelli has also designed a new anti-aircraft rocket.

• Air transport negotiations between Japan and Canada

A Canadian delegation has arrived in Tokyo for talks on a regular air transport agreement to replace the provisional agreement, under which Canadian Pacific Airlines have hitherto been operating the Vancouver-Tokyo-Hong Kong route.

• China pays compensation for shooting down of British aircraft

On the intervention of the British Government, Peking has agreed to pay compensation for the Douglas DC-4 of Cathay Pacific Airways shot down near Hainan on July 23rd, 1954. Compensation demanded and agreed to is £ 367,000 for the relatives of the victims, plus the cost of the aircraft and its cargo.

SERVICE AVIATION

• Reinforcement of the Swedish Air Force

Commander-in-Chief of the Swedish Armed Forces General N. Swedlund has published a *long-term programme for the expansion of the three armed services*, which calls for a gradual increase over ten years in the defence appropriations, from 2,021,000,000 crowns (1954-55 budget year) to 2,746,000,000 crowns (1964-65 budget year).—The Army's share of the total appropriations is to fall from 41% to 34%, and the Navy's from 20% to 17%, whereas the *Air Force's will rise from 32% to 37%*. By 1964-65 Air Force appropriations will rise to 1,000,000,000 crowns, with 66% of this sum being earmarked for aircraft procurement.

Special credits are to be included in future budgets for the *procurement of guided missiles*, under the heading " New weapons ". The 600,000,000 crowns allowed for under the present appropriations are considered by the Air Force to be inadequate.—The Swedish armed forces are to get three types of guided missile : a) anti-aircraft rockets or pilotless fighters for use against high-flying bombers ; b) guided missiles for use against ships ; c) rocket projectiles for air-to-air use.

Sabena's Chief Pilot Prosper Cocquyt has died suddenly in Brussels at the age of 54. Cocquyt made the first Sabena flight from Brussels to the Belgian Congo in 1935 and had recently been made Chief Pilot to the airline.

• Honest John rockets for Europe

According to the U.S. Defense Department several batteries of the U.S. Army's *Honest John* rocket are to be sent to N.A.T.O. forces in Europe. The rocket, which can carry an atomic warhead, has a range of 15 to 20 miles.

AIR TRANSPORTATION

• " The crush " over the Atlantic

The International Civil Aviation Organization's Third North Atlantic Regional Meeting was held at I.C.A.O. headquarters in Montreal in October and attended by delegates from 19 countries and 6 international organizations (I.A.T.A., F.A.I., World Meteorological Organization etc.), under the chairmanship of M.C.J. Teyssier (France). The Meeting discussed, among other things, measures to reduce the load on the air traffic control services due to the increase in Atlantic traffic. The number of Atlantic crossings is expected to be 60,000 for the whole of 1954, a figure which will increase by 50% within the next five years. Pending the construction of new Consol stations in Iceland, Greenland, Newfoundland and Labrador, the Meeting recommended that aircraft flying on the same or converging tracks should observe a minimum separation of 30 minutes' flying time, and those on parallel tracks should remain 120 nautical miles apart.

• Coordination of French air transport

While not prohibiting competition with Air France by private companies, the French Government's new decree on the coordination of air transport is directed against unregulated competition—Transport Minister Chaban Delmas used the word " anarchy ". Airlines are obliged to obtain prior Government approval for their procurement and operating programmes. The decree, which is to enter into force within a few weeks, must be passed by Parliament.

• P.A.A.-U.A.L. cargo agreement

Pan American World Airways and United Air Lines have agreed to coordinate their freight reservation systems. International forwarders will now be able to arrange for through cargo space on United's domestic system in the United States or on P.A.A.'s world-wide network. Consignors are required to prepare a single document only, which is used for complete transportation from point of origin to ultimate destination.

• Jet streams over the Pacific

Pan American World Airways has resumed its winter season non-stop services between Japan and Hawaii using the West-East jet streams prevailing at this time of the year. Experience during the past two years showed that these winds blow at speeds of up to 175 m.p.h. at 25,000 ft. altitude and continue until the beginning of May in the Pacific area.—It was its pioneering of jet streams which won for P.A.A. the 1954 Frye Airline Performance Trophy.

Change in Italian Air Force Command : (left) *General Aldo Urbani*, who has resigned as Chief of the Italian Air Staff on reaching retiring age, has been decorated by the United States Government with the Legion of Merit. Left to right : Colonel Cassaoy (United States Air Attaché), General Urbani, United States Ambassadress to Rome Mrs. Claire Booth Luce. (Right) : The new Chief of the Italian Air Staff, *General Ferdinando Raffaelli*, who has been Inspector General of the Italian Air Force since 1951.

* Extracts from *Interavia Air Letter*, daily international news summary, in English, French and German. All rights reserved.

• Change in J.A.L. management

Kunizo Hara, Chairman of Japan Air Lines, has told the Transport Minister and J.A.L.'s President that he intends to retire. The official reason given is bad health, but Japanese aviation circles believe that the real reason may be the company's unsuccessful attempts to raise its capital to 4,000,000,000 yen. Instead of the expected 1,000,000,000 yen, Japanese industry has subscribed only 300,000,000 yen.

INDUSTRY

• The Los Angeles aircraft industry employs 177,000

According to a statement by Captain Leland D. Webb, U.S. Navy (retd), Vice-President of the Aircraft Industries Association of America, the aircraft industry in the Los Angeles area now employs 177,000 persons, i.e., 29% of the region's total industrial personnel. Altogether California's aircraft industry employs 218,000 workers in plant covering a total area of 39,000,000 sq. ft. This labour force exceeds the total staff of all firms on the West Coast, including their Middle West and East Coast branches, in 1948. Order backlog for the Californian plants is given as $5,000,000,000.

• U.S. Defense Department calls for convertiplanes

In a special memorandum addressed to the military services and other technical organizations, the Air Coordinating Committee of the U.S. Defense Department calls for a speed-up in the development of convertiplanes. The Committee stresses, however, that responsibility for the development of commercial convertiplane prototypes will continue to rest with the private manufacturing companies.

• Lockheed special dividends

The Board of Lockheed Aircraft Corp., Burbank, California, has decided to raise the quarterly dividend for the third quarter of 1954 to $0.60 per share and to distribute a special dividend of $0.50 in cash and an additional share allocation of 5 % of the capital. During the past three quarters dividends have been $0.50 per share. — Board Chairman and President Robert E. Gross announced that profits for the third quarter would probably be $6,000,000, or nearly double those for the third quarter of 1953, which closed with a profit of $3,440,757. On September 30th, 1954 Lockheed had an order backlog of $1,031,062,000, compared with $1,522,341,000 on September 30th, 1953.

• New Fairchild Division

Fairchild Engine & Airplane Corp. announces the formation of a new Kinetics Division, to provide further diversification of the company's activities in the field of transportation equipment.

• Stuttgart Institute for Gas Turbine Physics

An " Institut für Physik der Strahlantriebe e. v. " (Institute for Jet Propulsion) has been formed in Stuttgart under the leadership of Dr. Eugen Sänger, to carry out research in the field of turbines, ramjet and rocket engines. Funds have been provided by the Federal Government, the Land of Baden-Württemberg, the Municipality of Stuttgart, and a number of industrial undertakings. In 1955 an Institute of Rocket Research is to be created at Stuttgart Technical University, which will incorporate the Jet Propulsion Institute.

FLYING EQUIPMENT

• *McDonnell* is working on the design of a *new all-weather fighter and low-level attack aircraft* for the U.S. Navy. Funds totalling $38,700,000 have been provided.

The *Dassault Mystère IV N*, the new two-seat night fighter version of the *Mystère*, which is undergoing flight testing at the Melun-Villaroche centre, has been demonstrated to a Dutch delegation. — *French Air Minister Diomède Catroux* has flown faster than sound in a Dassault *Mystère IV N* piloted by Captain Jean Lanvario. Left to right : Serge Dassault, Minister Catroux, Captain Lanvario, Major Guillaume.

• The first *Convair R3Y-2 Tradewind* Navy flying boat fitted with four Allison T-40 propeller turbines (5,500+ e.h.p. take-off power each) began flight testing at San Diego, California, on October 22nd. Applications : troop and freight transport, carriage of war materials, assault troop operations, ambulance services. For troop transport the type can be fitted with 120 rapidly removable backward-facing seats ; when used as a hospital aircraft it carries 92 wounded plus 12 attendants. — A limited fleet of R3Y-2s and R3Y-1s is to be put into service by the U.S. Navy in 1955.

• Douglas has published details of the *DC-7C* fitted with four Wright R-3350.EA-1 compound engines of 3,400 h.p. each : first-class cabin equipment for 62 passengers and technical crew of five plus cabin personnel.

With a span of 127 ft. 6 ins., a length of 112 ft. 3 ins. and a wing area of 1,637 sq.ft., the DC-7C has a structurally limited gross weight of 140,000 lbs. ; normal take-off weight is 139,000 lbs. ; max. payload 20,083 lbs. The aircraft has a level speed (at rated power) of 381 m.p.h. to 406 m.p.h. depending on weight ; at max. continuous power speeds are between 304 m.p.h. and 359 m.p.h. Rate of climb on four engines is still between 300 ft/min and 845 ft/min at 20,000 ft. again depending on weight ; service ceiling between 22,800 ft. and 28,000 ft. with four engines, between 16,300 ft. and 23,000 ft. on three engines.

Northrop F-89 Scorpion all-weather twin-jet fighter, which has been fitted experimentally with two automatically firing type T-110 rocket containers. The containers have been developed by the Armour Research Foundation, Chicago, at the request of the Army Ordnance Corps, for the U.S. Air Force

• A second *Lockeed C-130* military transport is nearing completion. Like the XC-130 prototype, it is being built at Lockheed's Burbank, California, plant.

• The new Mark VI version of the Canadair *Sabre* has now gone into production at Canadair's Montreal plant. It is fitted with an Avro-Canada *Orenda* turbojet of undisclosed mark and power. All that is known is that it is a more powerful version than the *Orenda 14* fitted in the Mark V (6,500 lbs. thrust).

• Static tests have been carried out at Toulouse on various components of SNCA du Sud-Est's *SE.210 Caravelle*. For example, a portion of the fuselage 8 ft. long was subjected to tests simulating 40,000 take-offs and landings and 60,000 flying hours. A third protoype is being built for further strength tests.

• Bréguet announces development of a target aircraft, the *Bréguet B.1060*, for high towing speeds (up to Mach 0.7). Conventional structure with straight wing.

• The *SIPA S.300* jet trainer (Turboméca *Palas*) is to complete its works testing in December 1954, so that it can be sent to the Government Flight Test Centre for further testing before the end of the year.

• The *Farman Monitor II* all-metal two-seater is in final assembly at Farman's Toussus-le-Noble plant. Its first flight is scheduled for the end of the year. Power plant : 240 h.p. Salmson engine.

• The delta-wing fighter of the Argentine Government factory Industrias Aeronauticas y Mecanicas del Estado briefly described in No. 11, 1954 (page 767) bears the type designation *IAME I.A.37* and was designed by Dr. Reimar Horten.

POWER PLANT

• A new version, NEl.4, of the Napier *Eland* is announced ; take-off power 3,765 h.p. Counting the residual thrust the NEl.4 falls into the 4,000 e.h.p. class and thus becomes a competitor to the Rolls-Royce RB.109.

• Bristol *Orpheus* turbojets (5,000 lbs. thrust) are to be fitted in other lightweight fighters and ground attack aircraft, in addition to the Folland *Gnat*. — A first prototype of this engine is to be ready for bench tests by the middle of 1955. It is reportedly to be equipped with a compressor of high compression ratio and have a very favourable performance/weight ratio.

Accessories Round-Up

● NEW EJECTOR SEAT

A lightweight ejector seat, the E.100, has been built by SNCASO, Paris, and is shortly to be installed in a number of French military aircraft types. By making the seat framework of welded steel tubes and using aluminium alloy for the operating system, it has been possible to reduce weight to only 53 lbs. The fully automatic ejection process falls into the following phases : 1- jettisoning of cabin hood, which releases the operating lever for the ejection of the seat ; 2- ejection of the seat ; 3- opening of the stabilizer parachute attached to the seat ; 4- automatic release of the seat belt in response to a time measuring instrument with air pressure measurement ; 5- opening of pilot's parachute.—Minimum release altitude for safe descent is said to be 500 ft.

● SPAR-SUPER PRECISION APPROACH RADAR

is the name of a new landing aid developed by the Laboratory for Electronics, Boston, Massachusetts. The rotatable antenna pedestal supports parabolic elevation and azimuth reflectors on outriggers. The reflectors can be oscillated back and forth twice a second. During oscillation the elevation beam travels through a sector of 10°, the azimuth beam through a sector of 30°. The indicator, a cathode ray tube of high resolution, separate from the antenna array, shows not only the approaching aircraft but also the electronically computed best approach flight path on the B-Scan principle, with altitude and bearing shown separately. Minimum acquisition range for a jet fighter of the Lockheed F-80 size is 10 miles. Other data : pulse frequency 2,000 c/s ; pulse width 0.5 μs ; peak power 50 kW ; carrier frequency 9,080 mc/s $\pm$ 1% ; power consumption 3 kW of

110V A.C. ; linear or circular polarization (to eliminate rain echos).—Its low overall weight of 2,000 lbs., its ready disassembly into compact sub-components for ease of transport and its ease of operation make the SPAR ideal for military use at advanced air bases.

● AIRCRAFT CRANE TRUCK

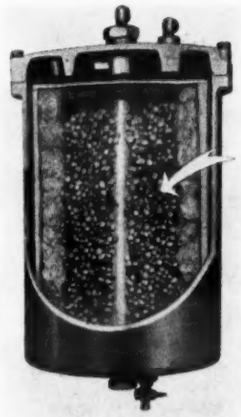
This mobile crane built by Unicum Works, Weert, Holland, is used for hoisting and transporting aircraft, aircraft parts and engines or other heavy loads. The vehicle comprises a two-wheel tractor with 195 h.p. diesel engine, which also acts as counter-weight, and a trailer with folding mast and boom. To increase transverse stability the rear axle can be extended. The whole crane weights 20 tons and can raise loads of up to 8 tons. Max. turning radius is 21 ft. 6 ins., total length of vehicle with mast and boom folded is 39 ft. 4 ins.

● A PORTABLE AIR COMPRESSOR, THE BOEING 502-7D,

for starting jet engines and checking pneumatic equipment has been developed by Boeing Airplane Co. over the past two years and has already successfully completed 200 hours of tests with the U.S. Air Force. Driven by a Boeing 502 small gas turbine, the centrifugal compressor delivers 90 lbs. of air per minute at an absolute pressure of 53 p.s.i. and a temperature of 220°C.—The twin-engined version shown here is being built for the U.S. Air Force under the B-52 bomber programme.

● JAPANESE OIL FILTER

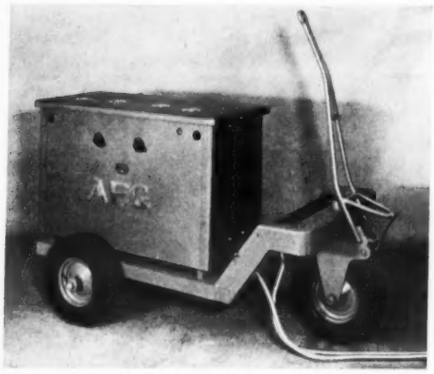
Tenichi Oil Filter, working on chemical and mechanical principles, has attracted the attention of U.S. Air Force units in Japan and of a number of automobile and engine manufacturers. The coarse-grained chemicals contained in the filter drum remove a large percentage of the carbon deposits from used oil. After one hour's filtration of a specimen of oil that had been used for 407 running hours, Japan's National Sources Technical Laboratory obtained the comparative results shown in the accompanying table. Inventor S. Tennojiya concludes from these figures that the filter elements in his new filter need be changed only every 400 running hours. At the same time fresh oil consumption would be reduced to roughly one third of the usual value.



本器の荷る切断面

Tenichi multi-purpose filter

	Fresh Oil	Reclaimed Oil	Waste oil after use
Colour	orange	dark orange	almost black
Specific density (compared with H_2O)	0.914	0.904	0.906
Viscosity	370	218	220
Mechanical impurities	0.18 %	0.23 %	1.12 %
Carbon residues	0.23 %	0.62 %	2.21 %
Ash	0.01 %	0.12 %	0.78 %



THE AEG ENGINE STARTING UNIT TYPE TG 1500

BY WERNER STOLTZ, BERLIN-FRANKFURT/MAIN

● The increasing power of both piston and turbine engines for aircraft has also augmented the demands on the source of energy used for starting these engines. The old pre-war battery carts—in a version suitable for use with gas turbine engines—would be so huge that they could only be moved by a full-sized truck and even then could only start up a small number of engines without recharging. The only solution would be to increase the number of batteries used.

A change-over has therefore been made in recent years to *mobile direct current generators* with diesel or petrol engines, which although much more costly than battery carts produce the required electric current on the spot and need no recharging equipment. A disadvantage of this system, however, is that the motor driving the generator must always be built for the peak load, whereas as a rule it is required only for lower outputs, often for hours at a time. The generator therefore has a low efficiency and is costly to operate; dimensions, weight and cost increase with the current required, as well as the often very disturbing noise. To avoid these disadvantages, *dry-cell rectifiers* have often been used, but these are unwieldy.

Attempts have therefore been made to find new methods of supplying current for aircraft on the ground. AEG, for example, who have for many years been making direct current generating units and dry-cell rectifiers, have developed a *mercury flow contact rectifier* for this purpose. This rectifier, which should not be confused with a mercury vapour rectifier, works on the same principle as the rectifiers used in trains for lighting by means of glow discharge tubes. It operates in roughly the same way as the mechanical contact rectifiers, such as AEG have been supplying for many years for very high amperage and efficiency, e.g. for electrolytic baths. Instead of fixed metal contacts, rotating mercury flows (inside a protective gas) are used to rectify the current.

The use of two diametrically directed flows gives fully balanced rotation of all rotating and pumping parts and avoids lateral stresses on the driving shaft. The unit's synchronous motor and rectifier are enclosed in a pressure-tight housing, to eliminate all possibility of failure due to leakages, such as may occur in bushings of mechanically operated parts.

The normal pressure of the protective gas is roughly 23 p.s.i. and increases with the electrical load due to rising temperature. Aggregate loads arising from successive starting processes (with cooling periods in between) are indicated by a manometer, so that the remaining load capacity can at all times be read off directly. Permissible maximum load is 33 p.s.i., but this is virtually never reached in practical operation.

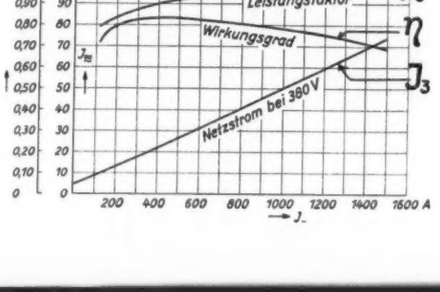
The new starting equipment has a high efficiency (low mains load) and high overload capacity. Continuous load is 300 A, peak load 1,500 A for 1.5 mins., max. continuous load 700 A for 15 mins. No other starting equipment with such small dimensions reaches these figures. Other special features are its small size ($22 \times 43 \times 26$ ins.) and low weight. Operating reliability is high; the equipment is unaffected by short circuits at the terminals, does not get "out of step" e.g., through mains irregularities, and costs little to operate and maintain.

The TG 1500 has many applications. Above all it can be used as a mains-operated, noiseless and exhaustless *mobile starter unit* inside or outside workshops, especially on the apron of airports, as well as for charging batteries and to supply current for testing purposes. Mounted in *parallel* it can supply high amperage and voltage for unusual aircraft types. Finally it can be combined with a mobile three-phase alternating current unit to form a *universal power source for airports*, to supply either three-phase alternating current (for machine tools, airport lighting, etc.) or direct current (to supply aircraft, batteries etc.). It can be mounted on a *single-axle chassis* (see picture), when it has the following dimensions: $6 \times 4 \times 4.4$ ft.

The equipment is normally supplied with step switch voltage selection. For a mains voltage of 380V, output voltage can be varied from 25.6 via 28.5 to 33V. Any mains voltage between 340 and 440 Volts three-phase A.C. can be used. Voltage drop is 0.4 to 0.5V per 100 A load. The equipment supplies 1,500A with an output voltage of 22.5V.

In addition to handy size, constant operational readiness, reliability and universal application, relative operating and cooling periods are also important in assessing the value of an engine starting equipment. With the unit under discussion a considerable number of starting processes can be completed in rapid succession, i.e. without lengthy cooling periods, as a small fan inside the unit provides constant cooling. AEG guarantees the given maximum load for 90 secs. without interruption. This means that about twelve average gas turbine engines can be started in succession, with 6 secs. peak load for each (without intervening cooling periods).—A number of these AEG units have been in use at German airports for some two years and have given full satisfaction.

Characteristics of the AEG mercury flow rectifier for output voltage U (in volts), load factor λ (cos φ), efficiency η and mains current input J_3 (in amperes) for 380 V mains voltage, all as a function of amperage J of the direct current supplied (abscissa). For example, for 1,000 A output, efficiency η is $1{,}000 \times 24.3/\sqrt{3} \cos \varphi \times 50 \times 380 = 0.77$



Book Reviews

The Greatest Airlift—the Story of Combat Cargo. By Captain Annis G. Thompson. Published by the 315th Air Division, U.S. Air Force, Tokyo, 1954 (English, 464 pages).

Captain Thompson, who kept a photographic diary of the Korean airlift, has here formed the pick of his entries into a detailed history of transport and airborne missions in the Korean war. Staff officers, pilots, mechanics, transport aircraft ... none has been passed over who made any contribution to this impressive feat of the U.S. Air Force in the Far East. " The Greatest Airlift " belongs in every aviation library. He.

Geschichte des Luftkrieges.—By Georg W. Feuchter.—Athenäum-Verlag, Bonn, 1954 (German ; 441 pages ; price DM 18.80).

The author was already active as an aviation writer before World War II : " Handbuch der Luftfahrt ", 1936 to 1939 editions ; " Probleme des Luftkrieges " 1936 ; " Flieger als Hilfswaffe " 1938 etc. From 1934 to 1939 he was responsible editor of " Deutsche Luftwacht—Ausgabe Luftwehr ", a magazine published by the German Air Ministry, and during the war he was press officer to the Luftwaffe Staff and finally with the military science section of the General Staff. There can therefore be no doubt of his competency, though whether the theme of his present book is not somewhat over-comprehensive is another question. World War I, Spain, World War II, Korea, present arms situation, forecast of future development ... In his foreword, the author himself states that a detailed history of aerial warfare cannot be written within the scope of a single volume ; hence the overall theme can only be dealt with in the form of a " study ", whose sole object is to promote understanding of the basic essentials of this history and to help the world to learn from past mistakes.—Looked at in this light, Feuchter's book is undoubtedly of some significance, particularly as a kind of preparation for the creation of a new German air force. This significance is not impaired by the fact that the author has had to rely principally on material already known, since the Luftwaffe Staff records were destroyed before the capitulation, and he had no access to the Western Powers' " official " documents. He.

Forschen und Fliegen. By Walter Georgii.—Verlag Fritz Schlichtenmayer, Tübingen, 1954 (German ; 339 pages).

Memoirs of the well-known German meteorologist Walter Georgii, written in entertaining vein. At the same time this is a lively account of German meteorology and gliding, with which the author has been closely connected since the first Rhön contest in 1920. For many years head of the Glider Research Institute at Darmstadt, Chairman of Istus and F.A.I.'s gliding commission, head of the Deutsche Seewarte, and after World War II head of the Argentine aeronautical research service ... a full life which passes before the reader in a series of living pictures. Anyone passionately fond of gliding will fall in love with Georgii's book. He.

Schweizerisches Lufttransportrecht. By Dr. A. Schweickhardt.—Scientia, Zurich, and Carl Heymann, Berlin-Cologne, 1954 (German ; 136 pages ; price Fr. 25.00).

With the Air Law of December 22nd, 1948 and the Air Transport Regulations of October 30th, 1952 (in force since February 1st, 1953) Switzerland has given herself the most up-to-date air transport legislation in the world. For this reason alone, Dr. Schweickhardt's book would deserve attention far beyond Switzerland's frontiers. Moreover the author has not treated his subject from the narrow, purely national point of view, but—as Dr. W. Berchtold, President of Swissair, indicates in his introduction—has also followed the latest developments in international legal theory and decisions. Here his professional experience and his position as head of Swissair's legal branch have been of great assistance. Dr. Schweickhardt's book is to be recommended to all air transport specialists, whatever their nationality. He.

Luftfahrt und Versicherung—a historical review of the foundations of German aviation insurance. No. 13 in the series published by the Insurance Institute of the University of Cologne. By Dr. Rudolf Schmetzke.—Verlag Duncker & Humblot, Berlin, 1954 (German ; 229 pages ; price DM 10.).

At first glance it might seem that the author has addressed himself to a severely restricted group of readers in choosing as his subject the history of aviation insurance, beginning with the first balloon ascents and finishing in 1918 and, moreover, limited to Germany (except for such points as the conclusion of agreements with foreign companies, etc.). However, on closer inspection, the book turns out to be not only " useful " but really gripping. The author knows how to write. Under his skilful pen the " history of aviation insurance " becomes a " history of aviation with special reference to insurance problems ". And this history includes so many original viewpoints that it makes good reading for anybody interested in flying. —Finally, despite the restricted period covered (up to 1918), the book cannot truly be called " out-of-date ". After all, the first air accident insurance policies go back to 1905-06, i.e., almost 50 years, and the first insurance on hull and fittings (for Zeppelin airships) 40 years. He.

Symposium on Frontiers of Man-Controlled Flight.—Edited by Dr. Heinz Haber. Published by the Institute of Transportation and Traffic Engineering, University of California.—Printed by Edward Brothers Inc., Ann Arbor, Mich., 1953 (English ; 109 pages and two large charts ; many illustrations and index ; price $2).

The present volume contains summaries of 18 papers read at a symposium on the future limits of manned flight held in Los Angeles, California, on April 3rd, 1953. Contributors were well-known aero-medical experts, aerodynamicists, designers and pilots : John R. Poppen M.D., Chairman of the Aeromedical-Engineering Association ; Edgar Schmued, Vice-President in charge of Engineering, Northrop Aircraft Inc. ; Dr. Charles F. Lombard, Impact Research Institute ; Dr. K. Buettner, University of California ; Stanley Lippert, Douglas Aircraft Co. ; Dr. C. A. Tobias, University of California ; Dr. H. Haber, University of California ; Herman P. Roth, Impact Research Institute ; Major Charles Yeager, U.S. Air Force ; C. M. Blockley, University of California ; Dr. J. H. Lyman, University of California ; Dr. L. E. Morehouse, University of Southern California ; Dr. Stanley N. Roscoe, Hughes Aircraft Co. ; Dr. N. D. Warren, University of Southern California ; Robert J. Shank, Hughes Aircraft Co. ; Alfred M. Mayo, Douglas Aircraft Co. ; Dr. J. Kaplan, University of California.

All the papers deal with the problems of the advance of modern aircraft into a realm hostile to life and of the growing complexity of their control and operation. Special attention is given to the search for means of overcoming the threat that aircraft are getting beyond the control of man, because he is physiologically and psychologically no longer a match for thei technical complications. Unfortunately it is not possible in the space available here to discuss in detail the various papers, which cover hundreds of problems of urgent importance from A to Z, from acceleration to zero gravity.

Reference will be made here merely to the fact that the aircraft industry (e.g., E. Schmued, of Northrop) expects military aircraft to reach ceilings of 65,000 feet and speeds of Mach 1.8 to 2 within the next eight to ten years and will therefore need suitable cabin cooling equipment, reliable life-saving and pressurizing equipment, heat and pressure-proof windows. In addition, the whole requirement of oxygen will have to be carried in the aircraft, and provision made for the removal of carbon dioxide, water vapour and smells inside the enclosed cabin. This example alone reveals the wide variety of problems remaining to be solved. The answers given in the articles are brief, often in diagrammatic form, and supplemented by extensive references to already published works.

An account of a discussion by a panel composed of all the contributors and in which mainly pilots took part, once again stressed the main points of human engineering in aviation. It closes with the remark by Dr. J. R. Poppen that " the time is here for a much more intimate and close coordination among the sciences and arts that are involved in our common problem ". Ri.

Flight Handbook—Fifth Edition.— By the editorial staff of " Flight ". Printed for " Flight " by Iliffe & Sons Ltd., London, 1954 (English ; 282 pages ; price 15 shillings).

Any reader interested in the present position of aeronautical engineering will go far to find another book which gives such a wealth of information in so condensed a form as this little handbook. Each chapter is carefully compiled so as to make the whole book interesting reading even for the uninitiated.—Begininng with *first principles of aerodynamics*, it then covers *airframes, landing gear, control systems, power plant* and *accessories* of the most varied designs, in almost all cases including the latest developments. The book also contains a discussion on modern *wing shapes* and their uses, and chapters on *helicopters, balloons and airships, piston engines, gas turbines, other reaction engines*, etc.

Of particular interest are the details given in the chapter on *gas turbines* of how an afterburner works, and of the new features introduced in the Rolls-Royce *Conway* by-pass engine. Another chapter is devoted to the *installation of engines* and includes a drawing of a Rolls-Royce *Avon* with reheat in the fuselage of the Hawker *Hunter* fighter. The instrumentation of a jet fighter is illustrated by a view of the cabin of a North American F-86E. Cut-away drawings of a number of aircraft and engine types show the complex nature of modern designs. Finally, auxiliary power systems are dealt with separately, such as pneumatic drives for generators and pumps. —The book is extremely well illustrated by more than 200 photographs and drawings and can be thoroughly recommended to all friends of aviation. Re.

Axialkompressoren und Radialkompressoren : Anwendung – Theorie – Berechnung. By Dr. Ing. B. Eckert, assisted by Ing. E. Schnell. — Springer-Verlag, Berlin-Göttingen-Heidelberg, 1953 (German ; 493 pages with 426 illustrations and 6 charts ; price DM 73.50).

Dr. Ing. B. Eckert, the main author of this work, is now head of the Stuttgart *Institut für Physik der Strahlantriebe* (Institute for Gas Turbine Physics) and a senior engineer with Daimler-Benz AG. He was formerly head of the fluid flow engines section of the Stuttgart *Forschungsinstitut für Kraftfahrwesen und Flugmotoren* (Research Institute for Motor Transport and Aircraft Engines) and, after the war, for several years leading compressor aerodynamicist at Turboméca S.A., Bordes, France (makers of a series of successful small gas turbines for aviation). Dr. Eckert has therefore been known in Germany and France for many years as an expert in his field, and above all as a designer of turbo-compressors for aircraft gas turbines. He has put great technical knowledge and a tremendous amount of work—using primarily his own research work but also covering the foreign documentation available up to the summer of 1952—into this *handbook for practical engineers on methods of calculating the aerodynamic qualities of turbo-compressors.* Above all, the book fills a definite gap in the literature on axial compressors, while providing a number of new points on radial compressors on which much more has already been written.

The book is divided into six *main sections* (A to G), each containing up to 13 *chapters.* It also gives six calculating charts, a very comprehensive bibliography (more than 550 titles) and a subject index. The following is a brief outline of the main sections :

A — *Determining design data for compressors* (general rules ; air renewal and cooling systems ; wind tunnels ; furnace and steel works blowers ; pneumatic feed systems ; superchargers for internal combustion engines ; gas turbines).

B — *Key values for fluid flow machines based on Newton's law of similarities* (object of key values ; law of similarity ; operating or throttling coefficient, non-dimensional revolution speed ; definitions ; interrelations ; choice of compressor design ; characteristics for compressible flow).

C — *Common physical principles of axial and radial compressors* (geometry of flow ; mechanical principles ; thermodynamic principles ; thermodynamics of compressors).

D — *The axial compressor* (introduction ; flow processes ; main dimension equation ; differential equation for gas turbine flow ; determining factors ; design types ; definitions ; calculating the main dimensions ; design principles for limit performance ; flow processes ; calculation of grids (in particular according to F. Weining) ; operating characteristics ; sample calculation).

E — *The radial compressor* (introduction ; flow processes and functioning ; influence of finite blade number ; definitions ; main dimensions ; rotor disc ; diffusers ; multi-stage radial compressor ; limit power compressor ; operating characteristics).

F — *Gas turbines in the unstable operating range* (conditions of stability ; breakaway of the flow ; surging of the compressor ; conversion of the surging limit ; reducing the surging tendency).

G — *Regulating the compressor* (regulation in the stable and unstable range of compressor characteristics).

The present work deals only with *subsonic compressors,* i.e. those whose flow speed is below the speed of sound. It will probably be several years before detailed scientific reports on supersonic compressors, such as will be used in aircraft engines of the future, can be made public. It should also be stressed that the book is restricted to *aerodynamic questions* —obviously with due consideration for temperature influences—and does not extend to strength or vibration problems or to metallurgical questions.

A particularly successful feature is the choice of symbols and key values, such as the " pressure factor ", " delivery factor ", " non-dimensional rotary speed " etc. With the aid of these key values it is possible to make a rapid calculation of the principal dimensions of axial compressors (Chapter D-VIII). A sample calculation covering about 20 pages gives the reader full details of how an axial compressor is designed for an aircraft jet engine, from the basic data (altitude, air mass flow, pressure ratio, aircraft speed, turbine speed) up to blade design. Similar examples are given to illustrate the " Radial Compressors " section.

From the point of view of the aircraft engineer, however, it would perhaps be desirable—for example in a new edition— to deal with certain points in greater detail, for instance the chapter on blowers and compressors for wind tunnels and the section on gas turbines for aircraft. An additional chapter on intake shapes and their effect on the compressor (in particular for aero-engines for both subsonic and supersonic flight) would also be welcome. As regards experimental and measuring methods for turbo-compressors, which have been omitted for lack of space, the author himself announces in his foreword that he is planning a separate work on this subject.

Nevertheless Dr. Eckert's book will undoubtedly become an indispensable standard work for all German-reading engine aerodynamicists and designers of fluid flow machines. Engineers working in industrial plants will also find much of value in the introductory sections A and B and in the remarks on compressor regulation. Finally, the book will be very useful to students and lecturers at technical colleges. It should find a place in all technical and scientific libraries. Ri.

Theory and Design of Steam and Gas Turbines. —By John F. Lee.—McGraw-Hill Book Company, Inc., New York, Toronto - London, 1954 (English ; 502 pages ; price 64s. 6d.).

The author, Associate Professor of Mechanical Engineering at North Carolina State College, has set out here to give a comprehensive but concise account of the theoretical fundamentals and design principles for steam and gas turbines. The problems of steam turbines and gas turbines are compared, with due mention of the special conditions applying to gas turbines. This method of presentation will appeal above all to engineers who have to transfer from steam turbine to gas turbine construction. The book also gives students an insight into the technical application of their theoretical knowledge in the fields of thermodynamics and mechanics of fluids. Two chapters on " Fundamentals of Thermodynamics " and " Elementary Gas Dynamics " have been included to enable readers with incomplete preliminary knowledge to get the best out of the book.—To sum up, a work written primarily for students of mechanical engineering and giving a good general view of an extensive subject ; it is equally valuable for introducing readers of other languages to English terminology. Re.

Books received :

The Gyroscope Applied.—By K.I.T. Richardson, M.A. — Hutchinson's Scientific and Technical Publications, London, 1954 (English ; 384 pages ; price 30 s.).

I.C.A.O. (English, French, Spanish) :

Manual of I.C.A.O. Standard Atmosphere. May 1954 ; Doc. 7488.

Publications scientifiques et techniques du Ministère de l'Air. —Distributed by Service de documentation et d'information technique de l'Aéronautique, Paris.

Mémoires sur la mécanique des fluides. No. 289, *Sur l'application de la théorie des lignes portantes à des ailes munies de spoilers,* by André Fauquet.

No. N.T. 49. *Le vrai problème du dépouillement des expériences,* by Pierre Vernotte.

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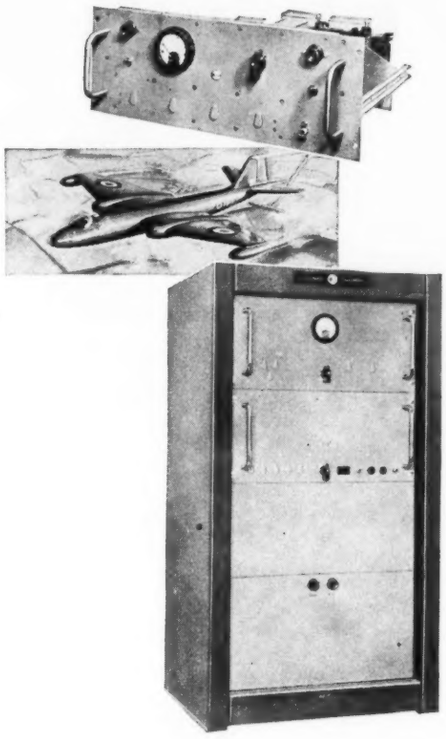
" One + Four... " Correction

During the printing of *Interavia* No. 11, 1954, the lay-out of the article " One + Four " on p. 760 had to be modified at the last moment, and in the course of this modification the photographs of the presidents of Aigle Azur, T.A.I. and U.A.T. became confused. The Editors apologize humbly for the slip and are reproducing the *three pictures again with the correct inscription.*

(left) **Sylvain Floirat,** President of Aigle Azur;
(centre) **Louis Vidal,** President of Union Aéromaritime de Transport ;
(right) **Paul Bernard,** President of Compagnie de Transports Aériens Intercontinentaux.



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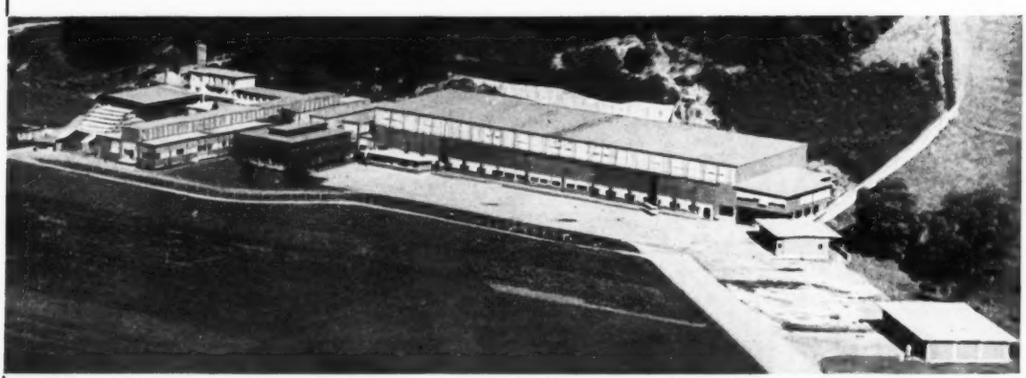

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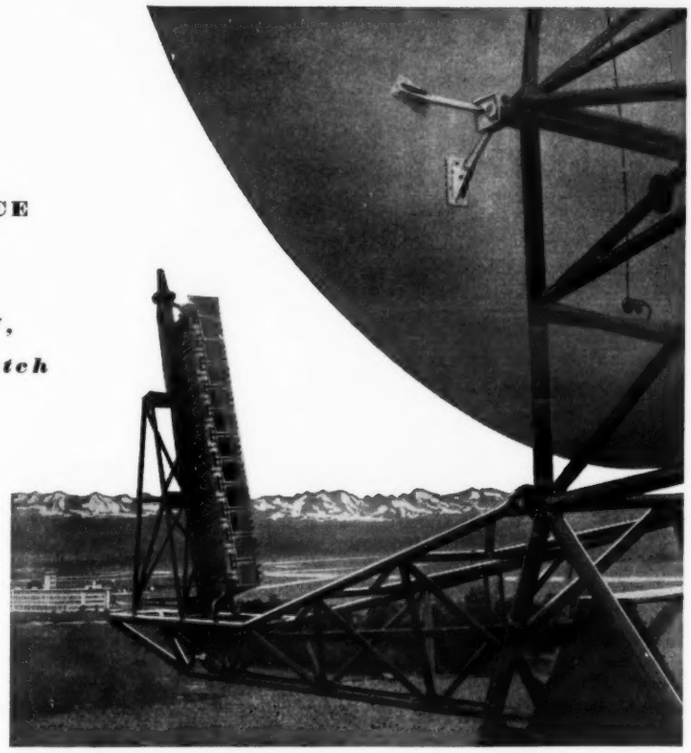

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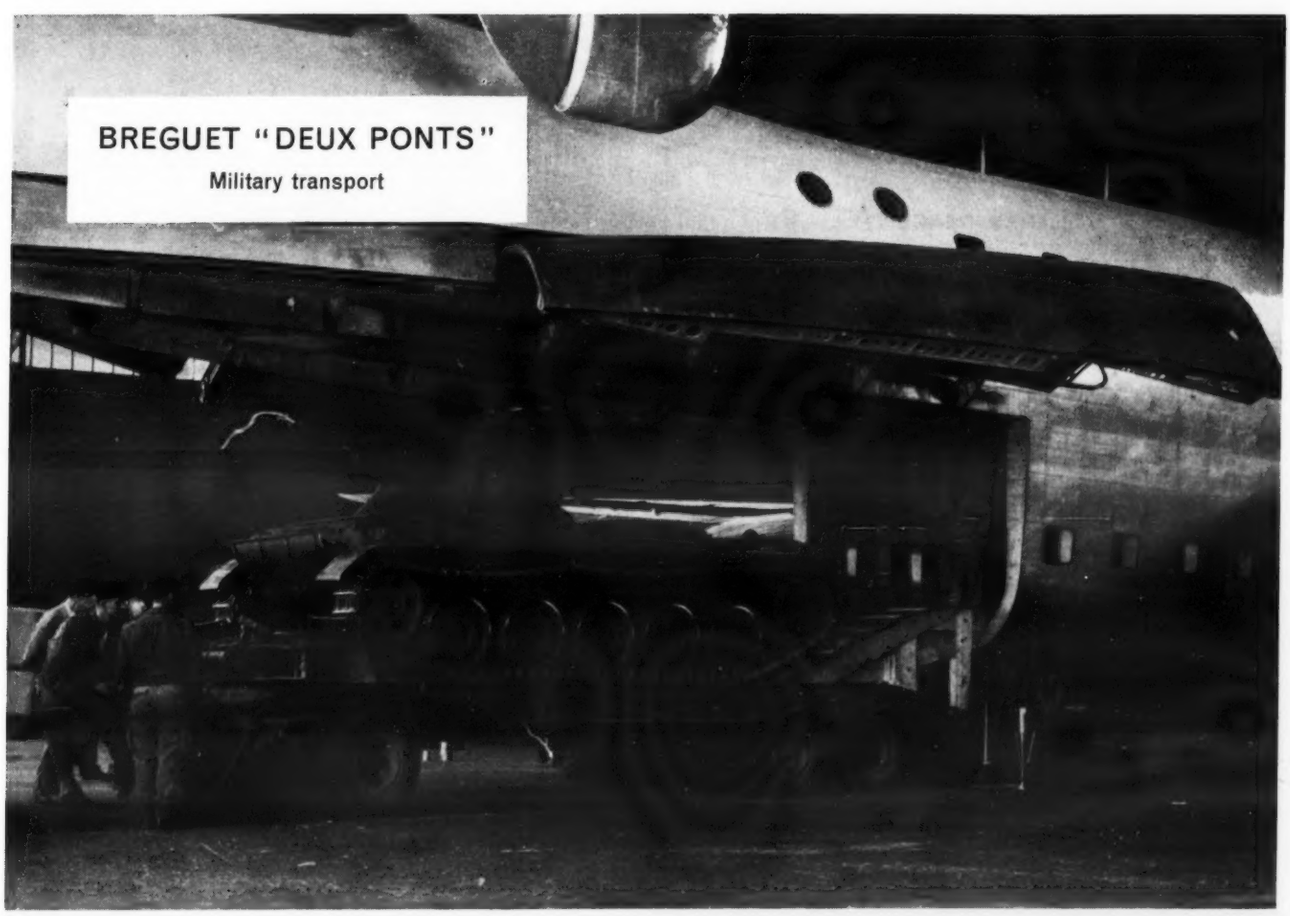

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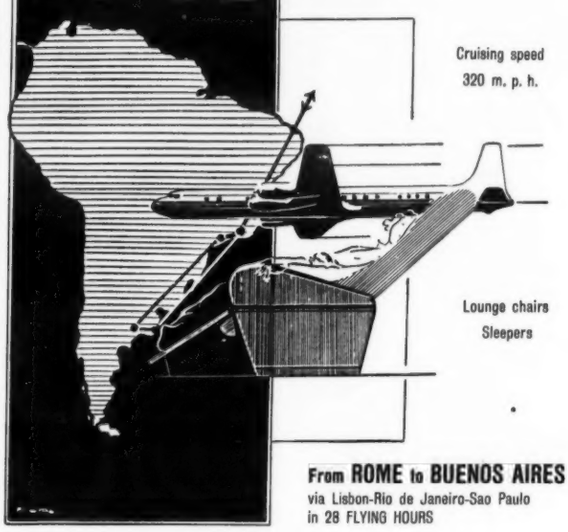

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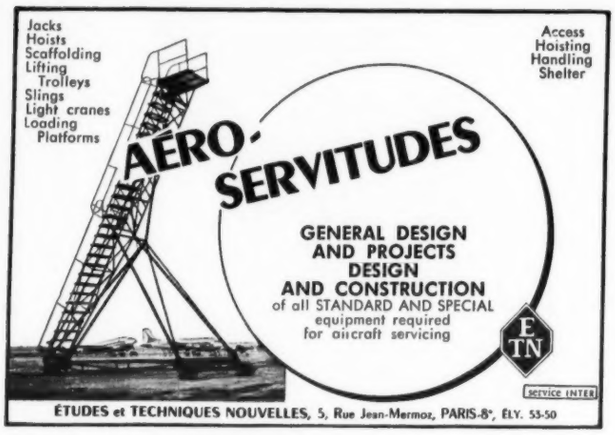

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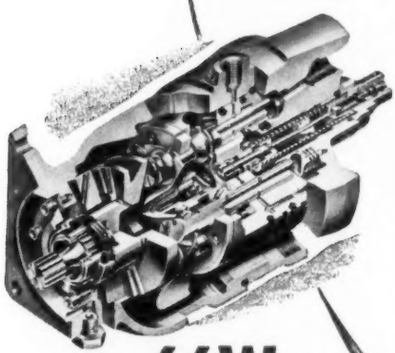

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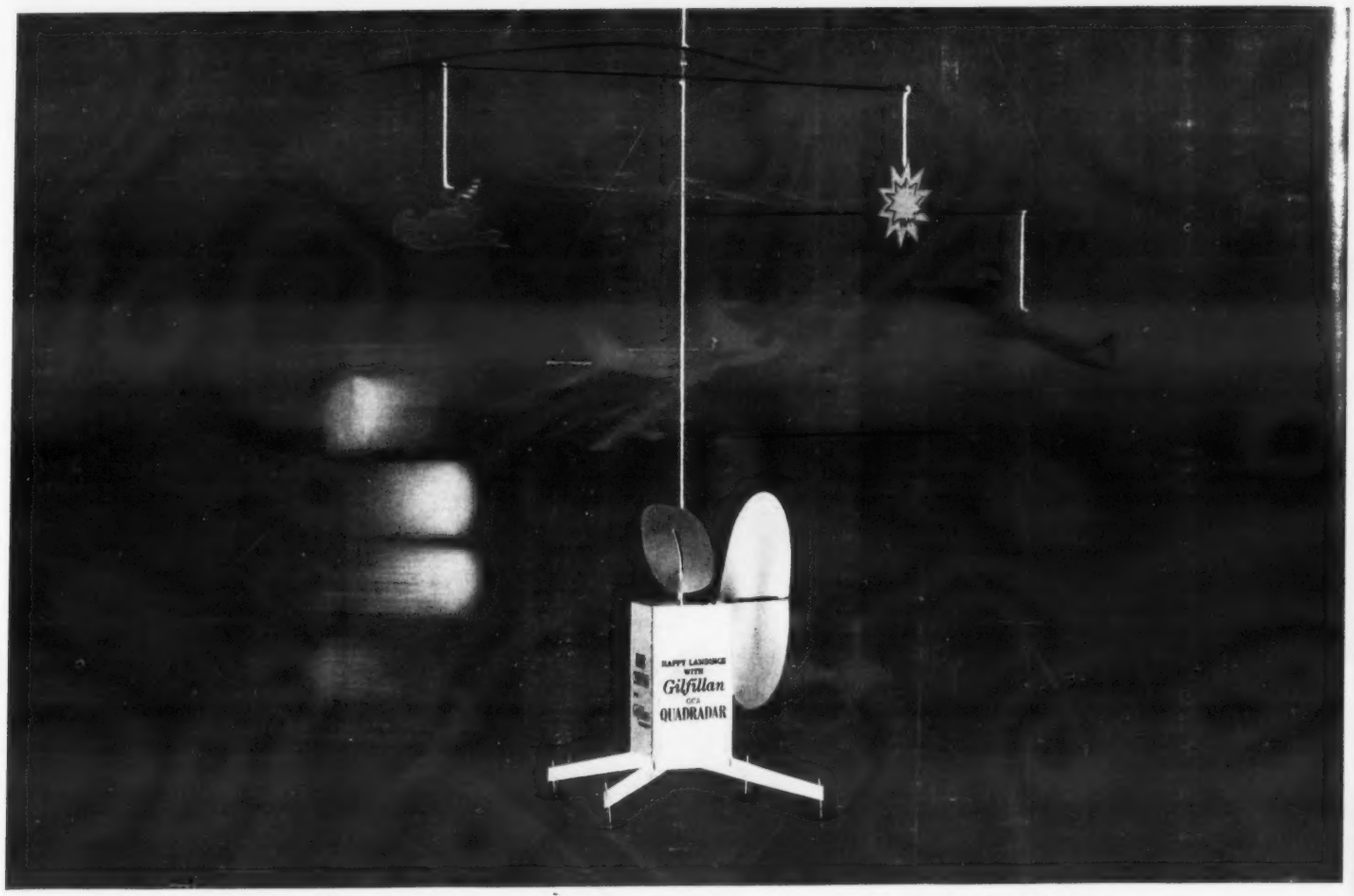
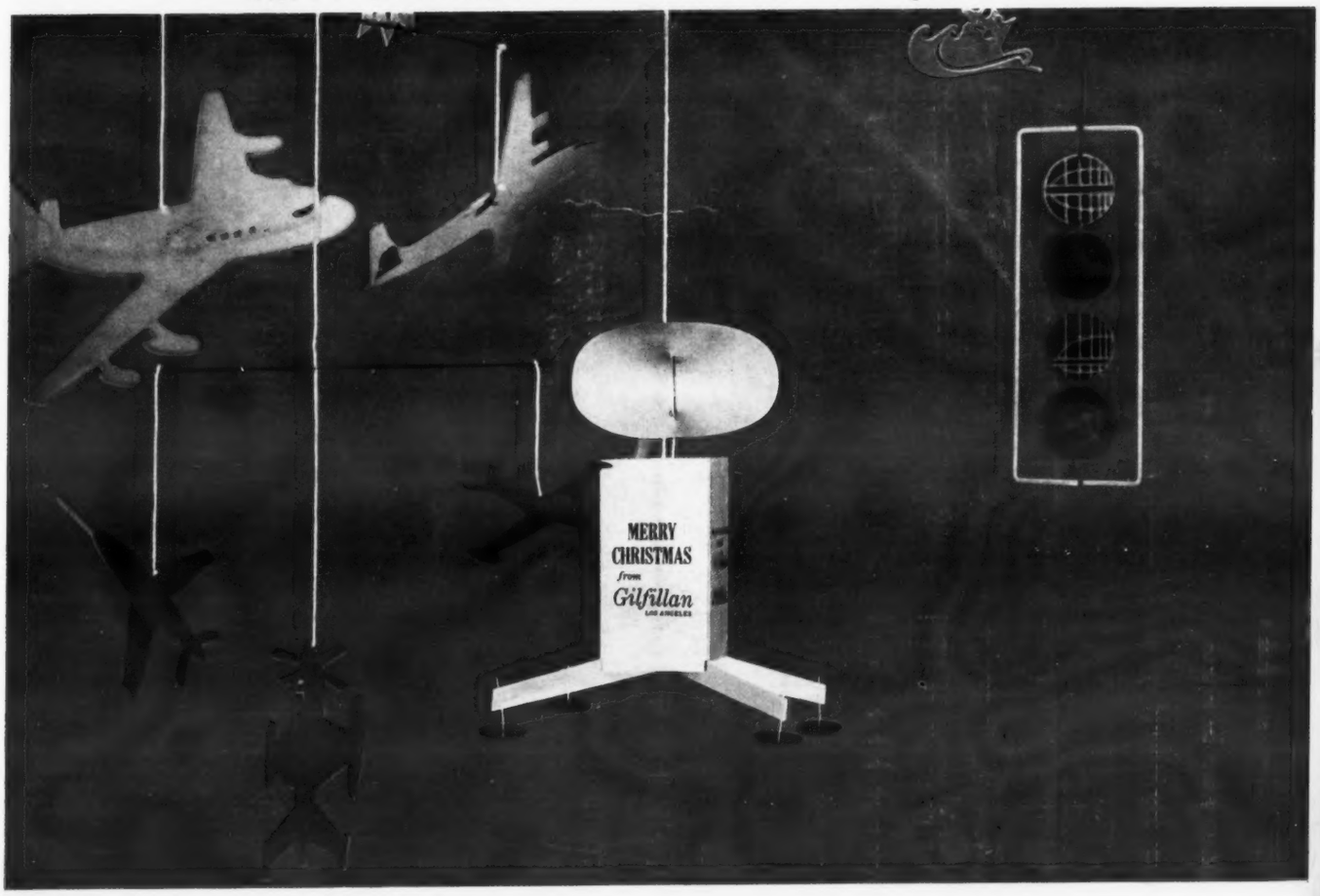
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